CAM-14 Acquisition Module
field service manual

PN 421315-001

Revision A

CAM-14 Acquisition Module

field service manual

PN 421315-001 Revision A

marquette

A GE Medical Systems Company

NOTE

Due to continuing product innovation, specifications in this manual are subject to change without notice.

MD1320-005

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Manual Information

Revision History

Each page of the document has the document part number followed by a revision letter located at the bottom of the page. This letter identifies the document's update level. The latest letter of the alphabet corresponds to the most current revision of the document.

The revision history of this document is summarized in the table below.

Table 2-1. Revision History

Revision	Date	Comment
A	18 December 1998	Initial release.

Manual Purpose

This manual supplies technical information for service representative and technical personnel so they can maintain the equipment to the assembly level. Use it as a guide for maintenance and electrical repairs considered field repairable. Where necessary the manual identifies additional sources of relevant information and or technical assistance.

See the host operator manual for instructions necessary to operate the equipment safely in accordance with its function and intended use.

Intended Audience

This manual is intended for the person who uses, maintains, or troubleshoots this equipment.

Safety Information

Definitions

⚠ DANGER — Indicates an imminently hazardous situation which, if not avoided, WILL result in death or serious injury.

⚠ WARNING — Indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.

⚠ CAUTION — Indicates a potentially hazardous situation which, if not avoided may result in minor or moderate injury.

Messages

Additional safety messages may be found throughout this manual that provide appropriate safe operation information.

⚠ DANGER

Do NOT use in the presence of flammable anesthetics.

M15287-1B

⚠ WARNING

Do NOT contact unit or patient during defibrillation.

M15287-8C

⚠ CAUTION

This equipment contains no user serviceable parts. Refer servicing to qualified service personnel.

M15287-38A

⚠ WARNING

Keep the conductive parts of lead electrodes and associated parts away from other conductive parts, including earth.

M15287-4C

⚠ CAUTION

Federal law restricts this device to sale by or on the order of a physician.

M15287-17A

Responsibility of the Manufacturer

GE Marquette Medical Systems is responsible for the effects of safety, reliability, and performance only if:

- Assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by Marquette.
- The electrical installation of the relevant room complies with the requirements of the appropriate regulations.
- The equipment is used in accordance with the instructions for use.

Intended Use

The CAM-14 acquistion module is intended to acquire analog ECG signal, digitize it and transmit the signal to a host unit. The circuitry is designed to protect the host unit against the effects of cardiac defibrillator discharge to ensure recovery.

This device is intended for use under the direct supervision of a licensed health care practitioner.

General

This equipment is protected against the effects of cardiac defibrillator discharge to ensure recovery, as required by test standards.

This equipment will not cause abnormal operation of the patient's cardiac pacemaker or other electrical stimulator.

This device uses a computerized ECG analysis program which can be used as a tool in ECG tracing interpretation. This computerized interpretation is only significant when used in conjunction with clinical findings. All computer-generated tracings should be overread by a qualified physician.

To ensure accuracy, use only computer-generated tracings and not the display for physician interpretation.

To ensure patient safety, use only parts and accessories manufactured or recommended by GE GE Marquette Medical Systems.

Contact GE Marquette Medical Systems for information before connecting any devices to this equipment that are not recommended in this manual.

If the installation of this equipment, in the USA, will use 240 V rather than 120 V, the source must be a center-tapped, 240 V, single-phase circuit.

Parts and accessories used must meet the requirements of the applicable IEC 601 series safety standards, and/or the system configuration must meet the requirements of the IEC 601-1-1 medical electrical systems standard.

The use of ACCESSORY equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of

safety of the resulting system. Consideration relating to the choice shall include:

- use of the accessory in the PATIENT VICINITY; and
- evidence that the safety certification of the ACCESSORY has been performed in accordance to the appropriate IEC 601-1 and/or IEC 601-1-1 harmonized national standard.

Equipment Symbols

The following symbols appear on the equipment.

M13932

Type BF equipment. Type BF equipment is suitable for intentional external and internal application to the patient, excluding a direct conductive connection to the patient's heart. Type BF equipment has an F-type applied part. The paddles indicate that the equipment is defibrillator proof.

Service Information

Service Requirements

Refer equipment servicing to GE Marquette Medical Systems' authorized service personnel only. Any unauthorized attempt to repair equipment under warranty voids that warranty.

It is the user's responsibility to report the need for service to GE Marquette Medical Systems or to one of their authorized agents.

Equipment Identification

Every GE Marquette Medical Systems device has a unique serial number for identification. The serial number appears on the product label on the base of each unit.

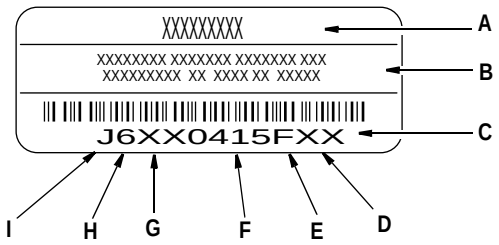

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Table 2-2. Equipment Identifications

Item	Name	Description
A	name of device	AM-114 Acquisition Module
B	manufacturer	GE Marquette Medical Systems, Inc.
C	serial number	Unique identifier
D	device characteristics	One or two letters that further describe the unit, for example: P = prototype not conforming to marketing specification; R = refurbished equipment; S = special product documented under Specials part numbers; U = upgraded unit
E	division	F = Cardiology G = Monitoring J = GW Labs
F	product sequence number	Manufacturing number (of total units manufactured)
G	product code	Two-character product descriptor MF = CAM-14 Acquisition Module
H	year manufactured	7 = 1997, 8= 1998, 9= 1999, (and so on)
I	month manufactured	A = January, B = February, C = March, D = April, E = May, F = June, G = July, H = August, J = September, K = October, L = November, M = December

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Technical Characteristics

General Description

The acquisition module performs high resolution ECG data acquisition for use with host equipment (resting ECG analysis systems and exercise systems). The acquisition module has the following features:

- ac leadfail bias,
- lead off detection,
- 4000 Hz sampling rate,
- patient isolation,
- software updates via floppy diskette, and
- Hi-Res analysis on 14-lead units
- function key control of host equipment functions

The acquisition module provides patient electrical isolation for the host equipment. The minute ECG signals from the patient's skin are received by the electrodes and sent to the acquisition module via leadwires. The acquisition module then amplifies, digitizes, and performs some processing on the signals.

This whole process is controlled by a microprocessor in the acquisition module. The acquisition module then sends the serial, digitized, ECG data to the host equipment in 16 bit "words". The host equipment communicates to the acquisition module using this same serial line.

Table 2-1. Safety

Item	Description
Certification	CE Marking for Council Directive 93/42/EEC
Type of Protection Against Electrical Shock	Not applicable
Degree of Protection Against Ingress of Liquids	Ordinary
Handling of Disposable Supplies and Other Consumables	■ Use only as manufactured or recommended by Marquette. ■ Follow manufacturer's instructions for use for disposable/consumable product. ■ Follow local environmental guidelines concerning the disposal of hazardous materials (e.g. lead acid batteries)
Patient Mode of Operation	Continuous
Patient Leakage Current	less than 10µA
Degree of Protection Against Electrical Shock	type BF applied parts

Table 2-1. Safety (Continued)	
Item	**Description**
Maintenance Frequency	■ Recommended user daily visual inspection and cleaning. ■ Recommended six-month routine maintenance checks and test procedures performed by qualified technical personnel.
Repair Guidelines	Calibration instructions, equipment descriptions, and all other service information to repair those parts of the equipment designated as field repairable by qualified technical personnel is available in the service manual. Upon request, GE Marquette Medical Systems will provide circuit diagrams and component parts lists for printed circuit boards deemed repairable by qualified technical personnel.

Table 2-2. Environmental	
Item	**Description**
Operating Instructions	
Temperature	0°C to 50°C (32°F to 154°F)
Relative Humidity	20% to 95% noncondensing
Atmosphere Pressure	70 to 106 KPa (PRELIMINARY pending final testing)
Storage Conditions	
Temperature	–20°C to 60°C (–4°F to 172°F)
Relative Humidity	5% to 95% noncondensing
Atmosphere Pressure	50 to 106 KPa (PRELIMINARY pending final testing)

Power Requirements

The acquisition module draws its power, 12 V dc, from the host unit. (See the host equipment's field service manual for the host equipment's power requirements.) The acquisition module provides the patient electrical isolation for the host equipment.

Operation

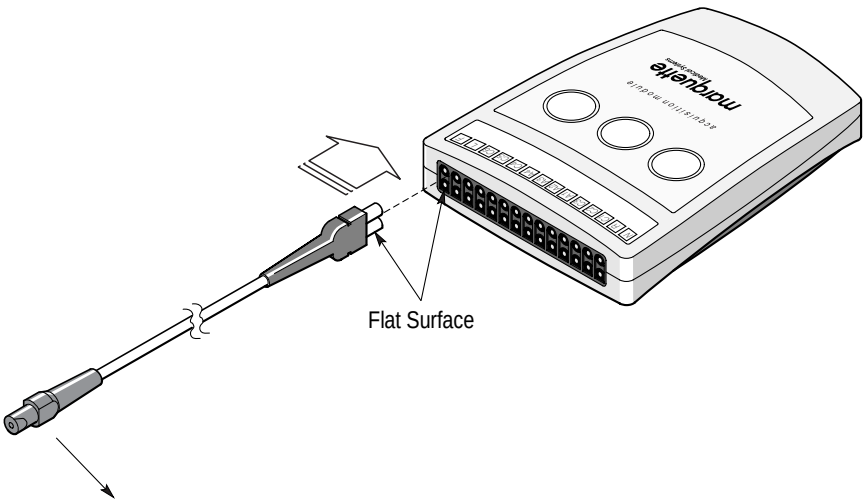
Operating Controls

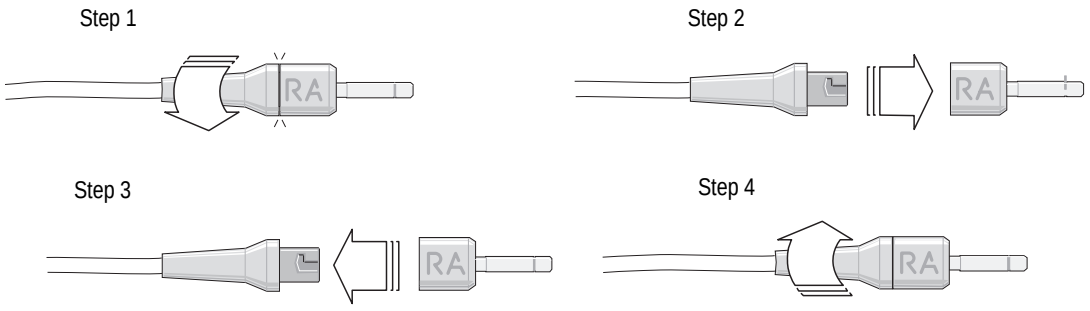
There are three controls on the acquisition module that are programmed by the host to record an ECG, record a rhythm, or stop the writer. See the host equipment operator's manual for the for specific information on using the acquisition module.

MD1320-002

Leadwire Attachments

The leadwires are shown with 2 ends. The figure below shows how to use both ends of the leadwires. There are various options for leadwire adapters, the 4 mm pin, stress grabber, or MACTRODE clip. See chapter 5, "Parts Lists and Drawings" for part numbers.





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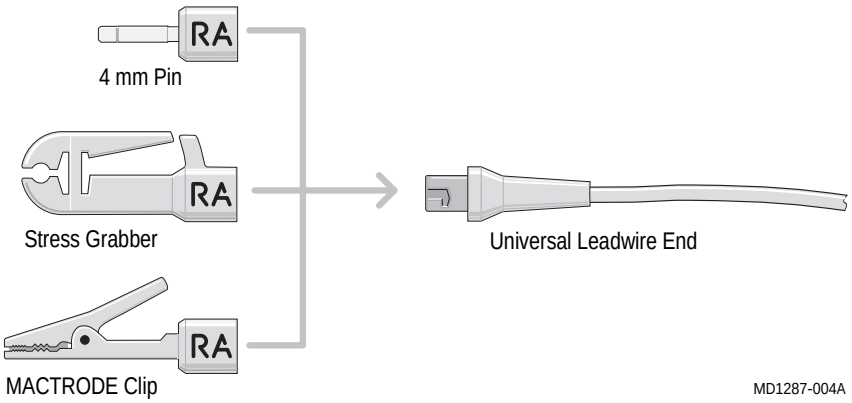
Leadwire Adapters

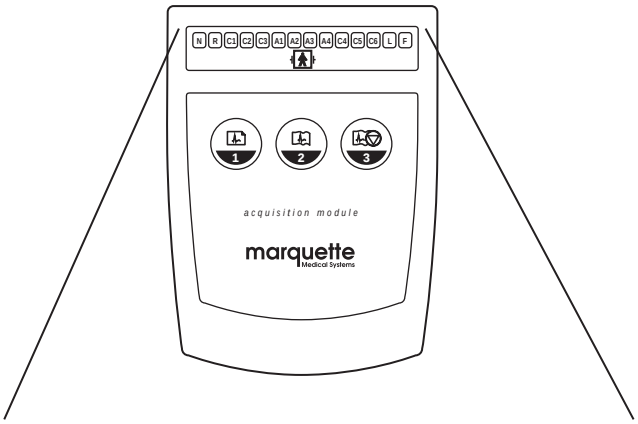
The acquisition module has universal leadwires which can be made into any lead of 3 basic types by using the adapters on the ends as shown in the figure below. The acquisition module leadwire adapters have a variety of configurations as shown below. (See chapter 4, “Parts Lists and Drawings” for part numbers for the various individual leadwire adapters.)



Refer to the figure on the next page for various labels that are affixed to the acquisition module for these configurations.

Lead Configurations

The various lead configurations are shown in the figure below. The acquisition module may be configured in any one of these ways. See chapter 5, “Parts Lists and Drawings” for part numbers.



10 Lead AHA: RL RA V1 V2 V3 V4 V5 V6 LA LL

14 Lead AHA: RL RA V1 V2 V3 H E I M V4 V5 V6 LA LL

14 Lead AHA Pediatric: RL RA V1 V2 V3 V3R V4R V7 V4 V5 V6 LA LL

10 Lead IEC: N R C1 C2 C3 C4 C5 C6 L F

14 Lead IEC: N R C1 C2 C3 H E I M C4 C5 C6 L F

14 Lead IEC Pediatric: N R C1 C2 C3 C3R C4R C7 C4 C5 C6 L F

14 Lead AHA AUX: RL RA V1 V2 V3 A1 A2 A3 A4 V4 V5 V6 LA LL

14 Lead IEC AUX: N R C1 C2 C3 A1 A2 A3 A4 C4 C5 C6 L F

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Recommended Maintenance

General

Other than daily cleaning and occasional visual checking, the acquisition module requires no maintenance.

Only qualified service personnel should attempt repairing components and assemblies internal to the acquisition module. For service and repair, return the acquisition module to the factory for 48-hour turn around service. Call Tech Support for assistance. (See the "How to Reach Us" page in the front of the manual.)

> **NOTE**
>
> Unless you have an Equipment Maintenance Contract, GE Marquette Medical Systems does not in any manner assume the responsibility for performing the recommended maintenance procedures. The sole responsibility rests with the individual or institution using the equipment. GE Marquette Medical Systems service personnel may, at their discretion, follow the procedures provided in this manual as a guide during visits to the equipment site.

Cleaning

Exterior Surfaces

Disconnect the acquisition module interface cable from the host equipment.

- Use a soft cloth moistened with water and a mild detergent. Wipe the exterior of the unit, the leadwires, and the acquisition module interface cable with the damp cloth. Dry all surfaces with a clean, soft cloth or paper towel.
- DO NOT allow any excess water to get inside the acquisition module or onto the leadwires or interface cable.
- Do not immerse acquisition module in water.
- Do not use alcohols, organic solvents, or abrasive cleaning agents.

Electrodes

- After each use, wipe reusable electrodes with a tissue or damp cloth to clean them of electrode paste. At the end of each day, wash reusable electrodes thoroughly with soap and water and dried.
- For suction electrodes, use a toothbrush to clean out the cups.

Visual Checking

Inspect the acquisition module each time you clean it or if you suspect a problem.

- Check the leadwires and leadwire adapters for wear and loose connections. Replace these parts at the first sign of wear.
- Check the pins that the leadwires plug into. They should not be bent or loose. Contact Tech Support for any repairs needed. (See the "How to Reach Us" page in the front of the manual.)
- Check the acquisition module plastic case for any damage. Contact Tech Support for any repairs needed. (See the "How to Reach Us" page in the front of the manual.)

Built-In Diagnostic Tests

The host equipment generally contains built-in diagnostic tests to verify the operation of the electrocardiograph.

These built-in diagnostic tests verify the operation of the acquisition module, as well. For example, there is a test that records raw ECG data on the thermal paper. This test checks for noise and gain in the acquisition module. Another test is a serial link test that determines if the microprocessor in the host equipment is communicating with the acquisition module.

For details on using these tests, see the field service manual for the host equipment.

Domestic Electrical Safety Tests

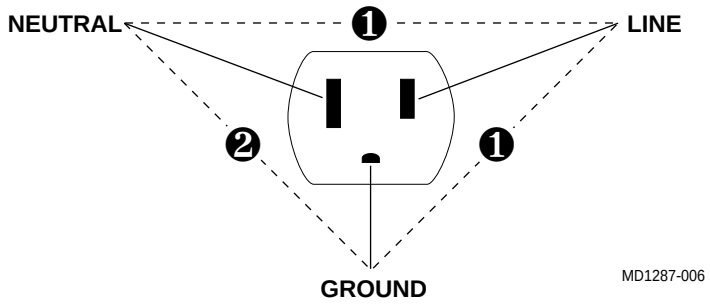
AC Line Voltage Test

This test verifies that the domestic wall outlet supplying power to the equipment is properly wired. For international wiring tests, refer to the internal standards agencies of that particular country.

120 VAC, 50/60 Hz

Use a digital voltmeter to check the voltages of the 120-volt AC wall outlet (dedicated circuit recommended). If the measurements are significantly out of range, have a qualified electrician repair the outlet. The voltage measurements should be as follows:

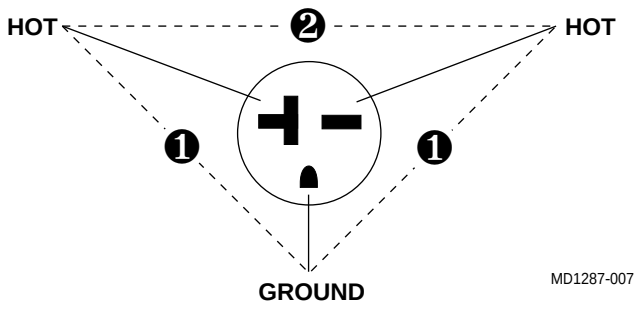
1. 120 VAC (± 10 VAC) between the line contact and neutral and between the line contact and ground.
2. Less than 3 VAC between neutral and ground.



240 VAC, 50/60 Hz

Use a digital voltmeter, set to measure at least 300 VAC, to check the voltages of the NEMA 6-20R, AC wall outlet (dedicated circuit recommended). If the measurements are significantly out of range, have a qualified electrician repair the outlet. The voltage measurements should be as follows:

1. 120 VAC (± 10 VAC) between either “hot” contact and ground.
2. 210 to 230 VAC between the two “hot” contacts.



Leakage Tests

The leakage tests are safety tests to ensure that the equipment poses no electrical health hazards. Use the table below to determine which tests apply to the unit under test and the maximum allowable leakage currents. For international leakage limits, refer to the internal standards agencies of that particular country.

If the unit under test fails the leakage tests, do not allow the customer to use the equipment. Call Tech Support for assistance. (See the "How to Reach Us" page in the front of the manual.)

GE Marquette Medical Systems recommends that you perform these tests:

- Before applying power for the first time
- Every 6 months as part of routine maintenance
- Whenever internal assemblies are serviced

You need a leakage tester to perform the leakage tests.

NOTE

The accuracy of the leakage tests depends on a properly-wired wall outlet. Do not proceed until you verify the integrity of the power source.

⚠ WARNING

Total system leakage current must not exceed 100 microamperes.

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Table 3-1. Leakage Tests and Maximum Allowable Leakage Currents

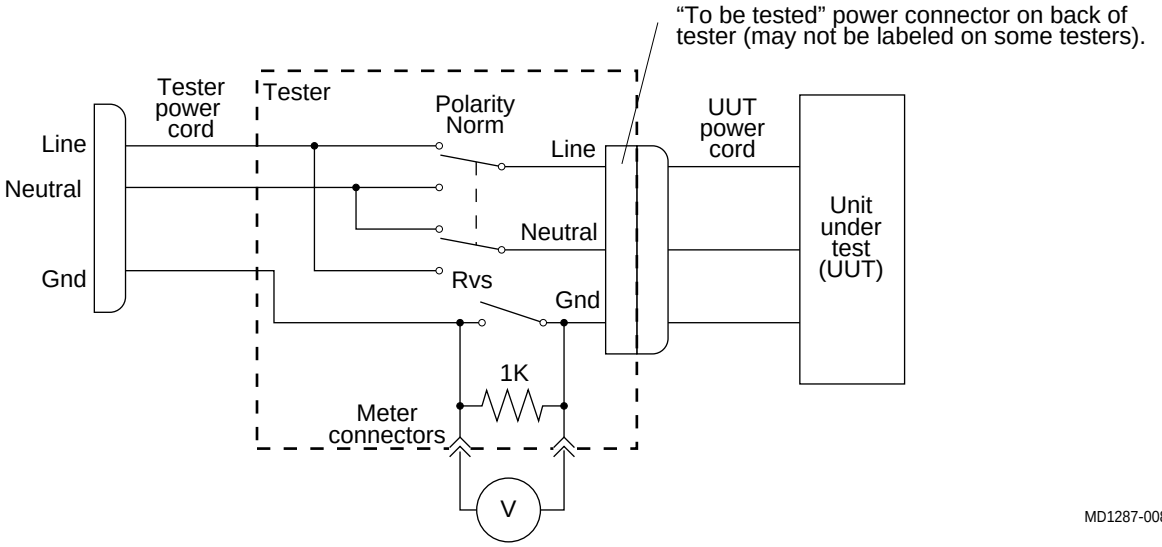
	Test	Applies To	Maximum Current (μA)
1	Ground-wire-leakage-to-ground	Host equipment	100
2	Chassis-leakage-to-ground	Host equipment	100
3	Patient-cable-leakage-to-ground	Acquisition module (patient cable)	10
4	Patient-cable-leakage-into-patient-leads-from-120 V ac	Acquisition module (patient cable)	20

Leakage Test Diagrams

These diagrams show only a representation of how a typical leakage current tester functions. Follow the instructions provided with the leakage current tester that you use.

Test #1

Ground-wire-leakage-to-ground



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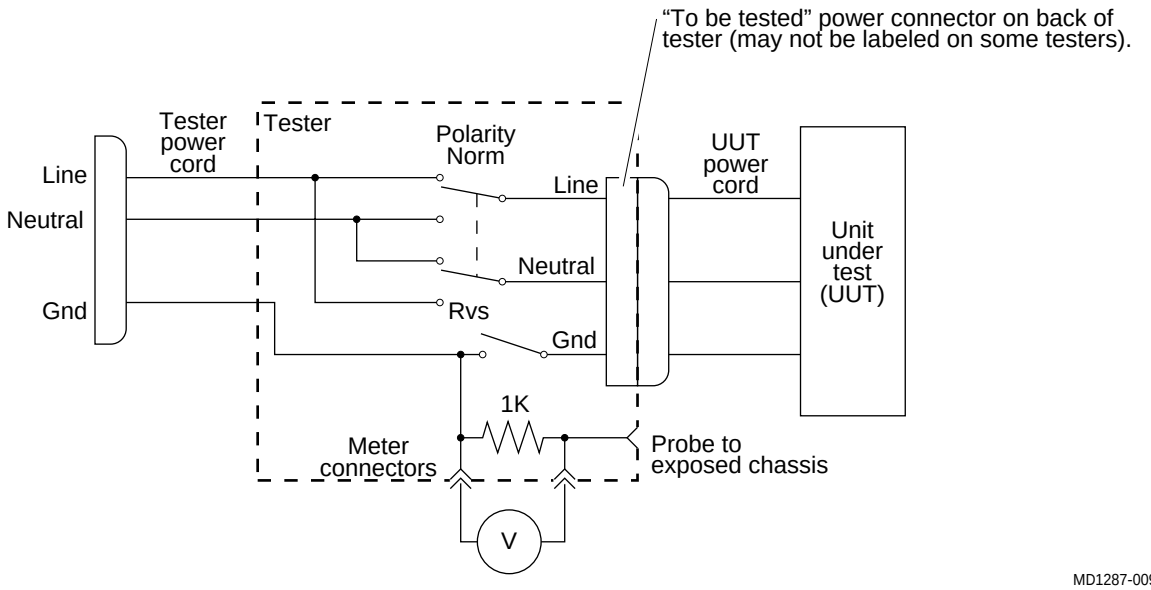
Test #2

Chassis-leakage-to-ground

Apply line voltage to the UUT chassis for this test.



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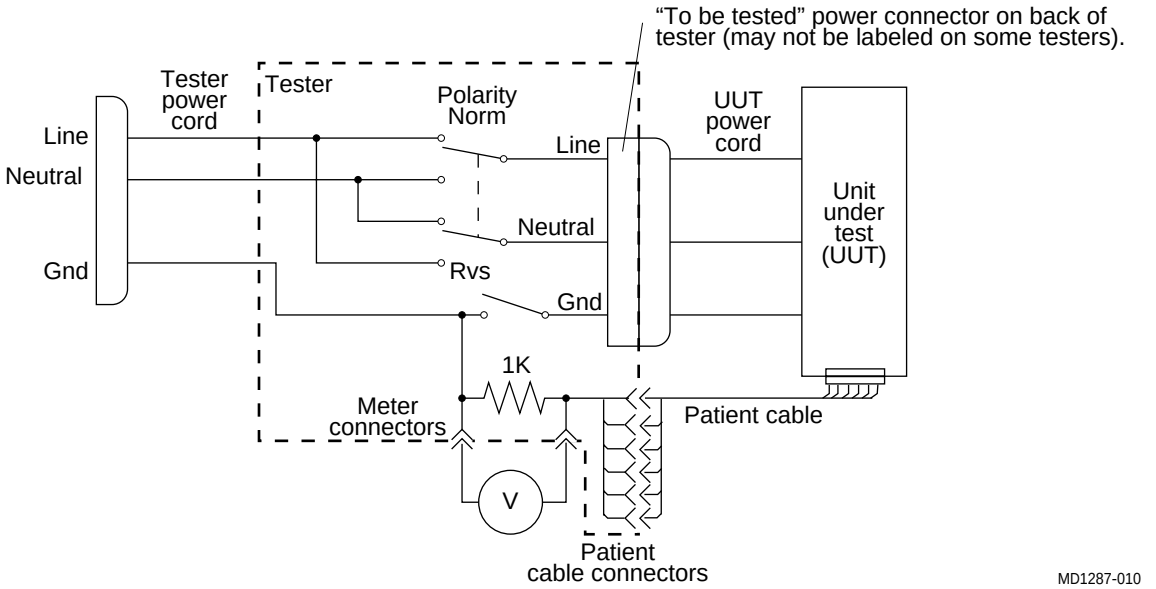
Test #3

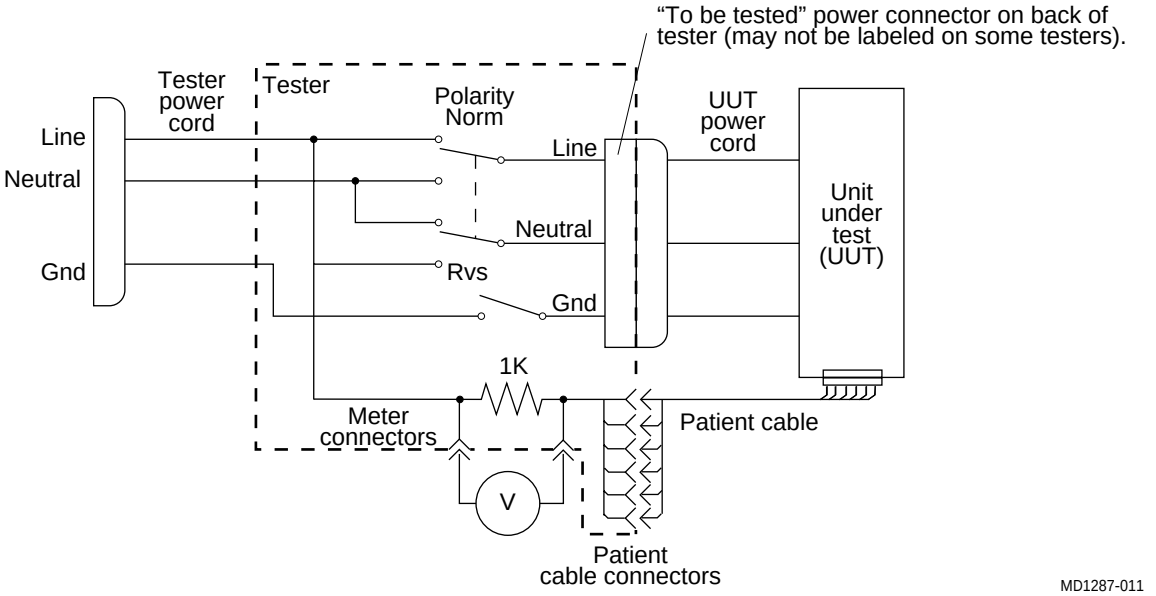
Patient-cable-leakage-to-ground



Test #4

Patient-cable-leakage-into-patient Leads-from 120 VAC

During this test, line voltage is applied to the patient cable connectors. To prevent erroneous readings, do not allow the leadwires to contact conductive materials such as metal handles, and do not place the leadwires on the floor.



Ground Continuity

This test verifies that there is continuity (less than 100 mΩ resistance) between all the exposed metal surfaces on the host equipment, which have the potential to become energized, and the ground prong on the mains AC power cord. If the metal surfaces are anodized or painted, scrape off a small area in an inconspicuous area for the probe to make direct contact with the metal.

Use a digital multimeter to check all the metal surfaces of the host equipment. Make adjustments for any resistance in the test leads. (See the host equipment field service manual for detailed information.)

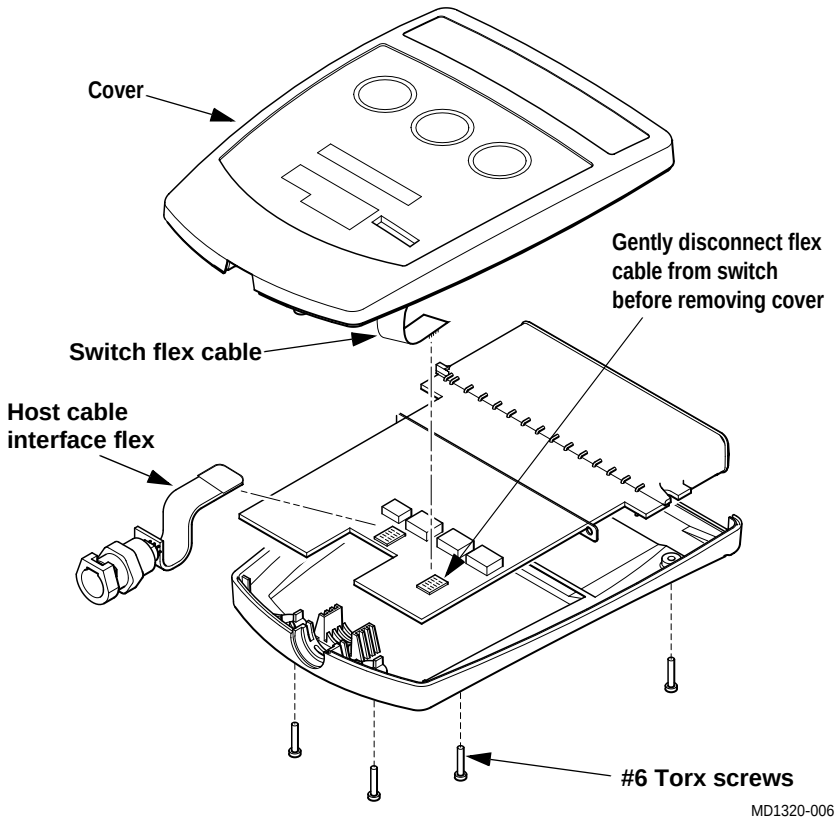
If the measurements are significantly out of range, check for breaks in the power cord or in the internal connections within the unit.

Disassembly

Strict antistatic precautions should be followed during disassembly/ assembly of the CAM-14.

NOTE

Use the proper ESD grounding techniques when handling components. Wear an antistatic wrist strap and an ESD protected mat. Store ESD sensitive components in antistatic bags before placing them on any surface.



Follow the steps below when disassembling the CAM-14.

1. Remove the four Torx screws holding the top and bottom of the CAM-14 unit together using a #6 TORX driver.
2. Lift the top only high enough to allow access to the switch flex cable from the switch assembly.

3. To avoid damage to the flex cable, gently pry the cable off the switch at the main pcb with a small screwdriver.

> **NOTE**
>
> Damage to the switch flex cable connector will result in failure of one or more of the switch functions.
>
> - **DO NOT** attempt to disconnect the switch flex cable by pulling on it.
> - **DO NOT** let the main pcb hang by the cable.

4. When the main pcb has been separated from the switch flex cable, disconnect the host cable interface flex from the main pcb by gently prying the connectors apart.

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900995-001A **Acquisition Module Assembly** **4**

420101-001B **14 Leadwire Kit** **7**

417483-9XXA **Leadwire, Multi-Link, Universal** **8**

900179-201 **Leadwire Adapter Kit - Banana** **10**

900179-202 **Leadwire Adapter Kit - Mactrode** **11**

900179-203 **Leadwire Adapter Kit - Grabber** **12**

Ordering Parts

Introduction

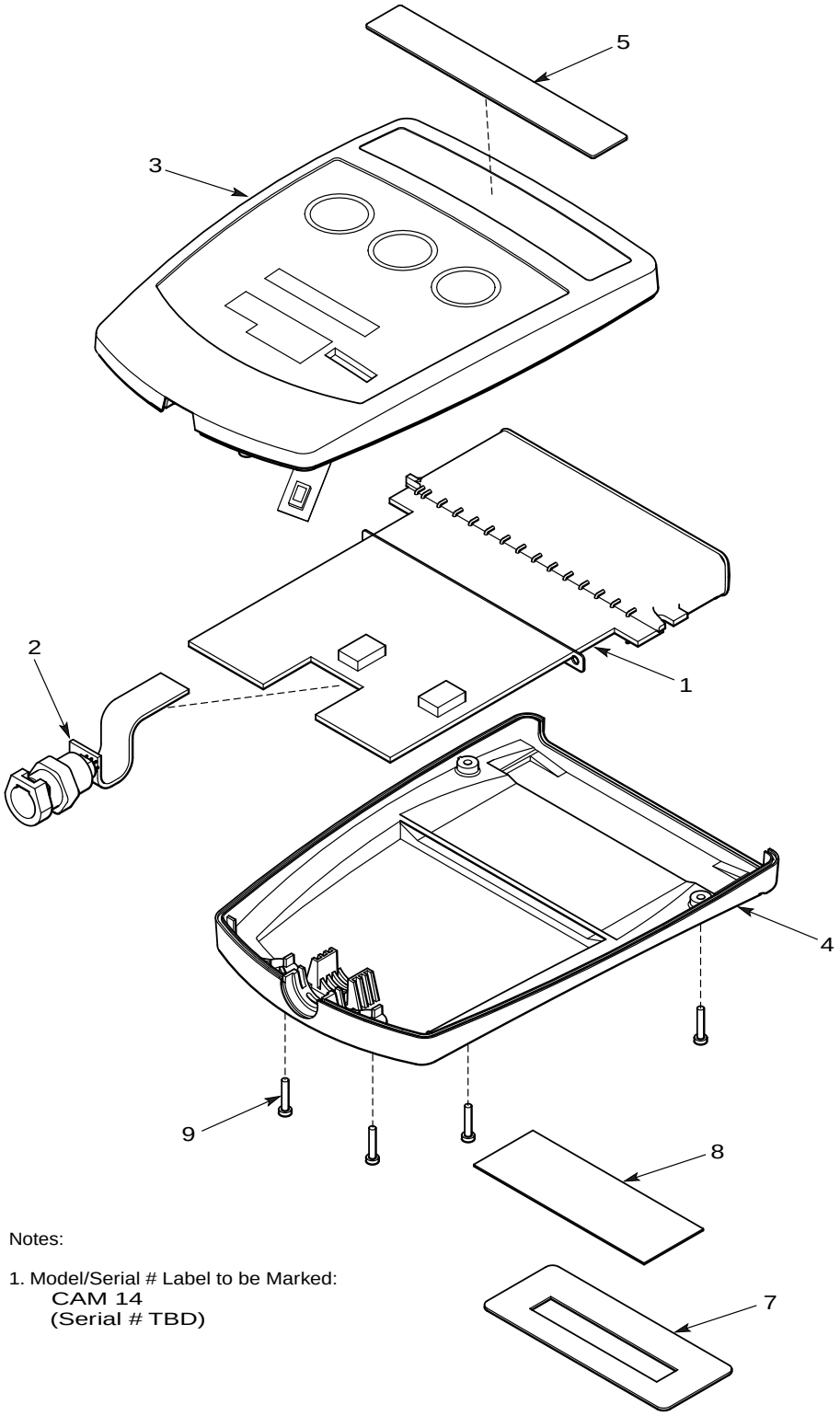
This chapter provides upper-level drawings for the standard configurations of the acquisition module and any kits which are available. It includes enough detail to provide part numbers for field-serviceable assemblies in the equipment.

Subassembly drawings follow the upper-level drawings and are arranged in ascending numerical order. The assembly drawings generally include both a parts lists and an exploded view.

To order parts, contact Service Parts at the address or telephone number on the “How to Reach Us…” page at the beginning of this manual.

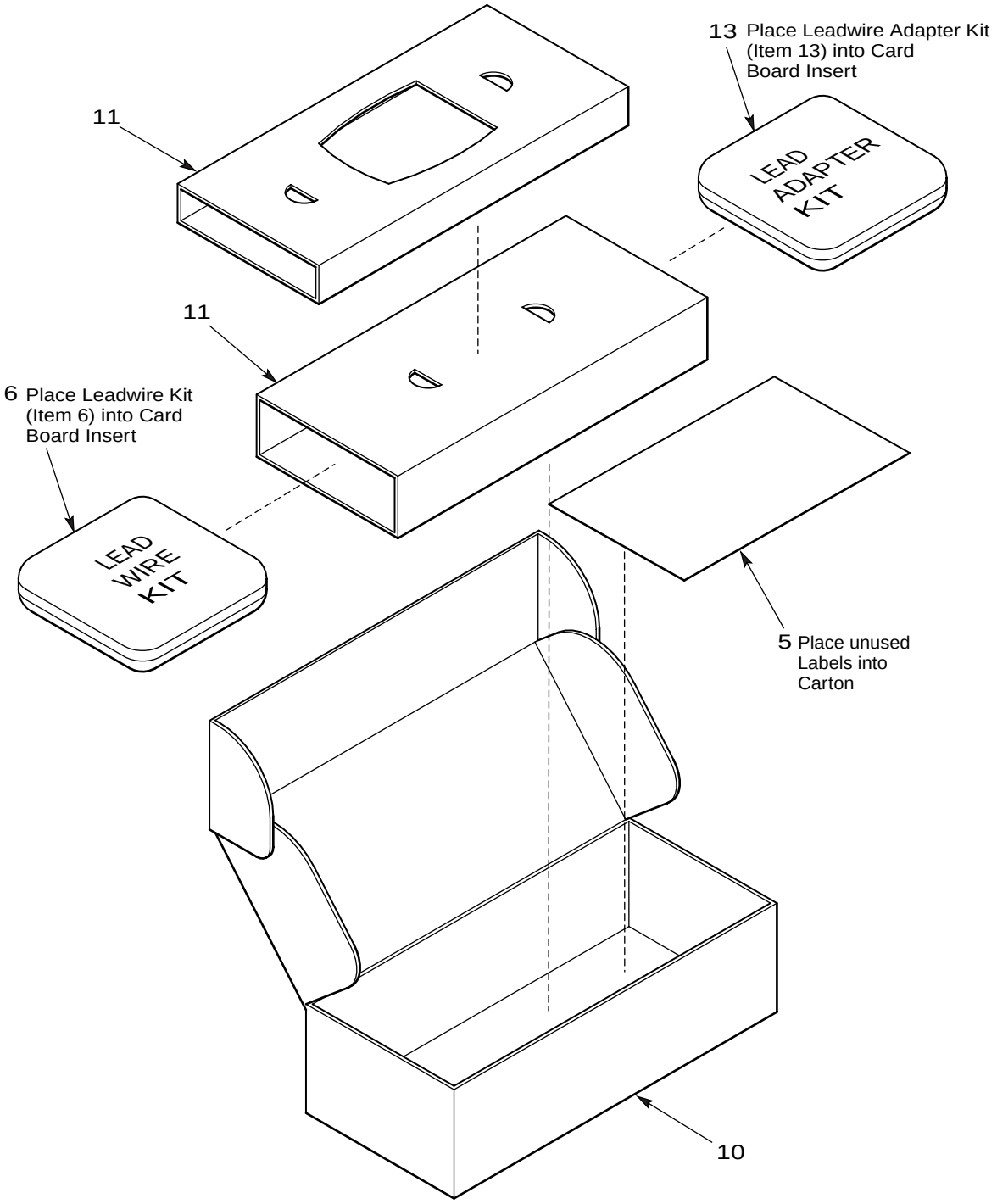
900995-001A Acquisition Module Assembly

Item	Description	Part Number	Qty.
1	PCB CAM 14 MAIN BRD	801280-001	1
2	PCB CAM14 CABLE INTFC	801502-001	1
3	ASSY TOP W/SWITCH CAM 14	422032-001	1
4	ASSY WELD BTM BELT CLIP CAM 14	420148-001	1
5	LABEL NEW ACQ MOD LD CODES	420152-001	1
6	KIT LDWR AM11X SET 14	420101-001	1
7	LABEL CLEAR OVERLAMINATE	413608-001	1
8	LABEL CAM 14 BOTTOM	419979-001	1
9	SCREW 1 X .375 TORX T-6 FHPH	417866-002	4
10	CARTON, MAILER 11X5X3 CAM 14	421927-001	1
11	INSERT, DIE CUT CAM 14	421927-002	1
12	I-STATIC, 6.00W x 8.00 L (not shown)	9976-005	1
13	PTR 14 SET AHA BANANA	900179-201	1



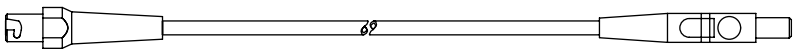
Notes:

1. Model/Serial # Label to be Marked:
   CAM 14
   (Serial # TBD)


13 Place Leadwire Adapter Kit (Item 13) into Card Board Insert
11
LEAD ADAPTER KIT
11
6 Place Leadwire Kit (Item 6) into Card Board Insert
LEAD WIRE KIT
5 Place unused Labels into Carton
10

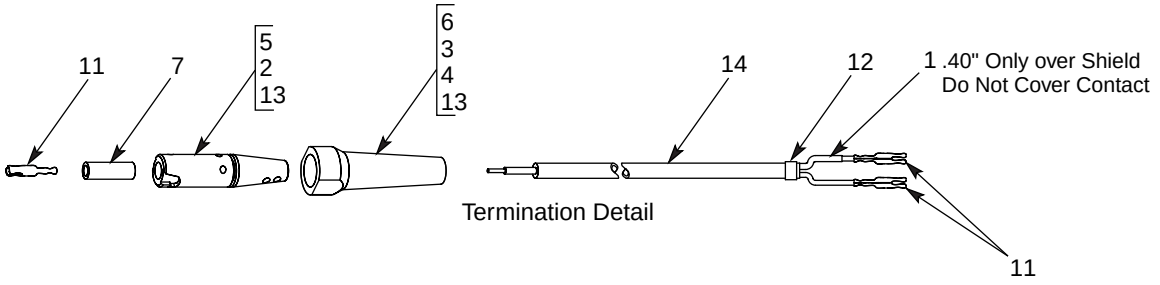
420101-001B 14 Leadwire Kit

Item	Description	Part Number	Qty
1	BAG, ANTISTATIC 6 X 8	9976-005	1
2	LEADWIRE UNIV/MLINK AM11X 26”	417483-905	10
3	LEADWIRE UNIV/MLINK AM11X 36”	417483-906	2
4	LEADWIRE UNIV/MLINK AM11X 40”	417483-903	2
5	INSERT/REORDER CARD	70357-001	1

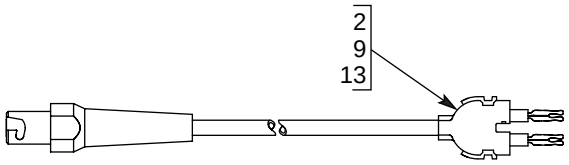


417483-9XXA Leadwire, Multi-Link, Universal

Item	Description	Part Number	Qty
1	TUBING FIT-221 3/32 BLK	4882-103	0.04
2	RESIN ABS NATURAL	5421-001	A/R
3	RESIN PVC 60 DURO NATURAL	5423-001	A/R
4	RESIN PVC 85 DURO NATURAL	5423-002	A/R
5	MOLD UNIVERSAL PREMOLD AM4	58973-058	1
6	MOLD STRAIN RELIEF AM4 WIRE	58973-059	1
7	INSERT MOLDED AM4 LEADWIRE	58973-060	1
8	LDWR PLUGFACE INDV MULTILINK DGRAY	411191-004	1
9	PLUG PREMOLD INDV LDWR MULTILINK	411192-900	1
10	PLUG OVERMOLD INDV LDWR MULTILINK	411193-001	1
11	LEADWIRE CONTACT	411197-001	3
12	BAND SPLICE	412201-001	1
13	COLORANT MULTIPURPOSE DARK GRAY	412793-028	A/R
14	CABLE COAX 1 COND 26 AWG. 125 OD PVC	700136-007	A/R



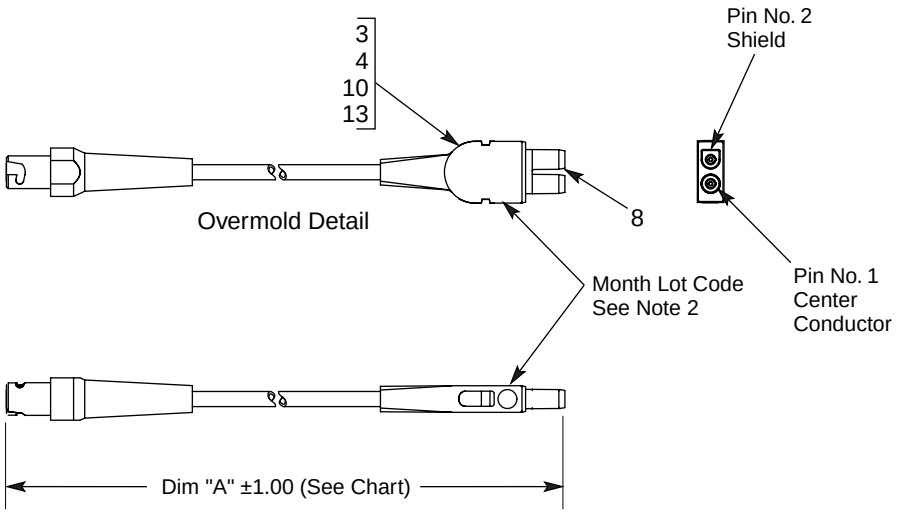
Termination Detail



Premold Detail

LENGTH CHART

REV	SUFFIX	ITEM 16 DIM "A" INCHES/FEET
A	-901	20"/1.70 FT
A	-902	29"/2.45 FT
A	-903	40"/3.35 FT
A	-904	51"/4.25 FT
A	-905	26"/2.17 FT
A	-906	36"/3.0 FT



Overmold Detail

Finished Part Detail

Notes:

1. For Overmold Mix PVC Resins Items 3 & 4 together to obtain 72 ±5 Durometer.
   Color: Gray, Munsell N7.

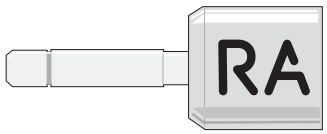
2. Month Lot Code: One letter in alphabetical order for each month where A = January,
   B = February . . . Skip letter "I".
   Year Lot Code: One digit, the last digit of the year where 7 = 1997, 8 = 1998 . . .

3. Performance Specification:
   Hi-Pot: Wire must withstand 5000 VDC 1 mA for 1 second between center Conductor and Shield.
   Continuity Test: Leadwire to be tested end to end between universal End & Center Conductor.

4. Finished Assembly to be free of dirt. Discolorations or other signs of poor workmanship. Molded Components to have Flash and Gate Marks trimed flush to within .010 of surface.

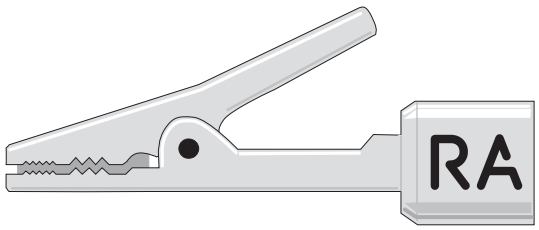
900179-201 Leadwire Adapter Kit - Banana

Item	Description	Part Number	Qty
1	ASSY BANNANA RL GREEN	406554-007	1
2	ASSY BANNANA RA WHITE	406554-001	1
3	ASSY BANANA LL RED	406554-005	1
4	ASSY BANANA LA BLACK	406554-003	1
5	ASSY BANANA V1 BROWN	406554-009	1
6	ASSY BANANA V2 BROWN	406554-011	1
7	ASSY BANANA V3 BROWN	406554-013	1
8	ASSY BANANA V4 BROWN	406554-015	1
9	ASY BANANA V5 BROWN	406554-017	1
10	ASSY BANANA V6 BROWN	406554-019	1
11	ASSY BANANA E ORANGE	406554-021	1
12	ASSY BANANA H ORANGE	406554-023	1
13	ASSY BANANA I ORANG	406554-025	1
14	ASSY BANANA M ORANGE	406554-027	1



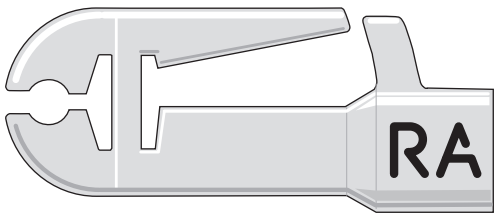
900179-202 Leadwire Adapter Kit - Mactrode

Item	Description	Part Number	Qty
1	ASSY MACTRODE RL GREEN	406551-007	1
2	ASSY MACTRODE RA WHITE	406551-001	1
3	ASSY MACTRODE LL RED	406551-005	1
4	ASSY MACTRODE LA BLACK	406551-003	1
5	ASSY MACTRODE V1 BROWN	406551-009	1
6	ASSY MACTRODE V2 BROWN	406551-011	1
7	ASSY MACTRODE V3 BROWN	406551-013	1
8	ASSY MACTRODE V4 BROWN	406551-015	1
9	ASY MACTRODE V5 BROWN	406551-017	1
10	ASSY MACTRODE V6 BROWN	406551-019	1
11	ASSY MACTRODE E ORANGE	406551-021	1
12	ASSY MACTRODE H ORANGE	406551-023	1
13	ASSY MACTRODE I ORANG	406551-025	1
14	ASSY v MACTRODE M ORANGE	406551-027	1



900179-203 Leadwire Adapter Kit - Grabber

Item	Description	Part Number	Qty
1	ASSY GRABBER RL GREEN	406552-007	1
2	ASSY GRABBER RA WHITE	406552-001	1
3	ASSY GRABBER LL RED	406552-005	1
4	ASSY GRABBER LA BLACK	406552-003	1
5	ASSY GRABBER V1 BROWN	406552-009	1
6	ASSY GRABBER V2 BROWN	406552-011	1
7	ASSY GRABBER V3 BROWN	406552-013	1
8	ASSY GRABBER V4 BROWN	406552-015	1
9	ASY GRABBER V5 BROWN	406552-017	1
10	ASSY GRABBER V6 BROWN	406552-019	1
11	ASSY GRABBER E ORANGE	406552-021	1
12	ASSY GRABBER H ORANGE	406552-023	1
13	ASSY GRABBER I ORANG	406552-025	1
14	ASSY v GRABBER M ORANGE	406552-027	1



5 PCB Assemblies

8001280-001A **Data Acquisition Module 3**

SD8001280-001A **Schematic, Main Board 8**

8001280-001A Data Acquisition Module

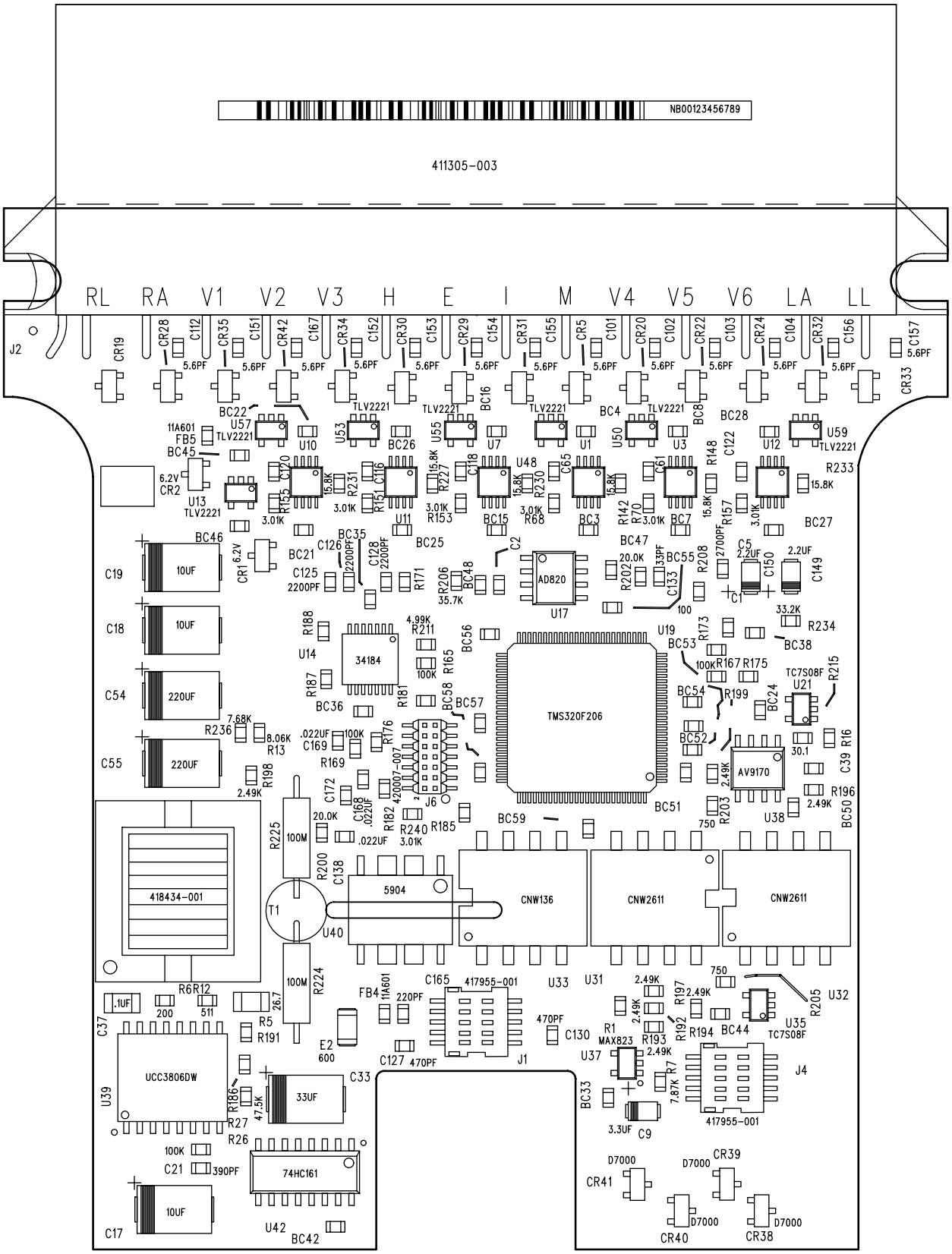
Item	Description	Part Number	Qty.
1	RES COMP 100M 5% 1/4W	1001-107	2
2	RES SM CER 100 5% 1/8W	1081-101	1
3	RES SM CHIP 5% 1/8W 51 OHMS	1081-472	1
4	RES SM CER 26.7 1% 1/8W	1082-909	1
5	CAP SM CER COG 150PF 5% 50V	1181-151	13
6	CAP SM CER X7R .1UF 50V	1187-104	2
7	DIODE SM SERIES PR D7000	2013-201	4
8	DIODE SM SCHTKY BARRIER 2800	2412-001	1
9	DIODE SM LL FDSO1503	2414-001	14
10	IC SM HC 74HC161	3038-161	1
11	IC SM SSOP VHC04	3057-004	1
12	IC SM SSOP VHC573	3057-573	1
13	DIODE SM ZENER 5234 6.2V	401502-001	2
14	CAP SM TANT 1.0UF 10% 16V	406883-002	3
15	CAP SM TANT 10UF 10% 35V	406884-013	3
16	IC SM DUAL N-CHAN MFET SI9955	407547-001	1
17	BEAD SM 1206 600@100 200MA	408746-001	3
18	IC SM HCMOS TC7S02F	408795-001	2
19	IC SM OPTOCOUPLER CNW2611	408825-001	2
20	IC SM HCMOS AND TC7S08F	409035-001	2
21	RES SM 0603 100 1% 1/16W	410334-003	1
22	RES SM CER 0603 10K 1% 1/16W	410334-013	22
23	RES SM 0603 11.5K 1% 1/16W	410334-014	1
24	RES SM 0603 3.01K 1% 1/16W	410334-018	13
25	RES SM 0603 100K 1% 1/16W	410334-019	7
26	RES SM CER 0603 0 OHM JUMPER	410334-027	1
27	RES SM 0603 511 OHM 1% 1/16W	410334-034	1
28	RES SM 0603 47.5K 1% 1/16W	410334-036	1
29	RES SM 0603 200 OHM 1% 1/16W	410334-044	2
30	RES SM 0603 7.68K 1% 1/16W	410334-049	1
31	RES SM 0603 20.0K 1% 1/16W	410334-053	6
32	RES SM CER 0603 4.99K 1% 1/16W	410334-066	1
33	RES SM CER 0603 35.7K 1% 1/16W	410334-091	2
34	RES SM 0603 7.87K 1%	410334-098	3
35	RES SM 0603 750 1%	410334-099	3
36	RES SM 0603 1.24K 1%	410334-101	1
37	RES SM 0603 30.1 1% 1/16W	410334-109	1
38	RES SM 0603 2.49K 1% 1/16W	410334-110	7
39	RES SM CER 0603 8.06K 1% 1/16W	410334-113	2

Item	Description	Part Number	Qty.
40	RES SM 0603 1.0M 1% 1/16W	410334-120	3
41	RES SM 0603 33.2K 1% 1/16W	410334-165	1
42	RES SM 0603 249K 1% 1/16W	410334-186	2
43	RES SM 0603 15.8K 1% 1/16	410334-225	12
44	CONN BLK,CAM 14 14POS W/10K R	411305-003	1
45	CAP SM X7R 0603 .1UF 10% 16V	411575-002	80
46	CAP SM X7R 0603 1000PF 5% 50V	411575-003	2
47	CAP SM X7R 0603 390PF 5% 50V	411575-009	1
48	CAP SM X7R 0603 2700PF 5% 50V	411575-010	2
49	CAP SM X7R 0603 0.01UF 5% 50V	411575-012	2
50	CAP SM X7R 0603 .022UF 16V 5%	411575-014	4
51	CAP SM X7R 0603 220PF 5% 50V	411575-022	4
52	CAP SM X7R 0603 3300PF 5% 50V	411575-024	1
53	CAP SM NPO 0603 100PF 5% 50V	411575-025	2
54	CAP SM X7R 0603 2200PF-5%	411575-033	3
55	CAP SM NPO 0603 33PF 5% 50V	411576-004	1
56	CAP SM NPO 0603 5.6PF +/-25PF	411576-017	13
57	CAP SM NPO 0603 470PF 5% 50V	411576-018	3
58	CAP SM X7R 0805 .047UF 5% 25V	411587-004	1
59	IC SM DUAL OP AMP TLC272CD	411710-001	1
60	RES SM 0603 10M 5% 1/16W	411723-003	1
61	SM RESONATOR 4MHZ TYPE KBR	412010-001	1
62	IC SM OPTOCOUPLER CNW136	412017-001	1
63	CAP SM TANT 220UF 20% 10V	412662-002	2
64	CAP SM TANT 33UF 20% 25V	412662-003	1
65	IC SM OP AMP AD822	412753-001	1
66	IC SM OP AMP LOW POWER AD82O	412799-001	1
67	CAP SM TANT 3.3UF 10% 10V	413119-001	1
68	DIODE SM SCHTKY RECT MBR0520	413970-001	2
69	SM FERRITE BEAD 0603 BLM11A601	414061-001	5
70	CAP SM TANT 2.2UF 10V 10%	414084-001	2
71	IC SM PWM CONTROLLER UCC3806DW	414247-001	1
72	IC SM 4.85V REG MIC5201	416998-001	1
73	IC RS485/422 XCVR MAX490 SO8	417913-001	1
74	CONN SCKT SM B/B 2MM HGT 10POS	417955-001	2
75	TRANSFORMER TNI ISO T8175	418434-001	1
76	IC SM DSP TMS320F206 PQFP	419051-001	1
77	IC SM D FLIP TC7W74FU	419131-001	1
78	IC SM AV9170-02	419133-001	1
79	IC SM OP AMP TLV2221 SOT23-5P	419134-001	13
80	IC SM TPS 5904	419135-001	1
81	IC SM MAX4051	419283-001	2

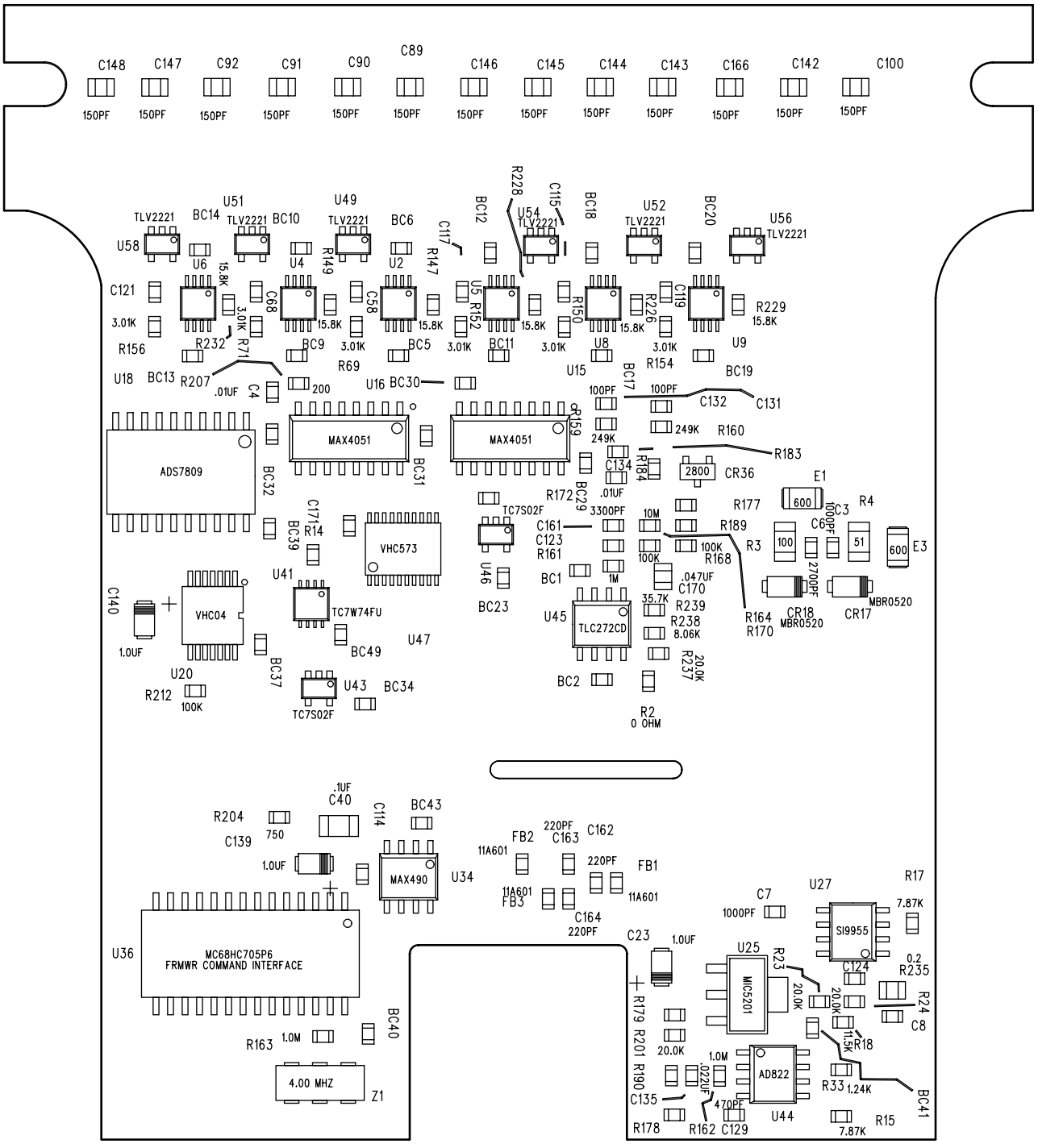
Item	Description	Part Number	Qty.
82	IC SM INSTR AMP INA126E SSOP	419315-002	12
83	IC SM QUAD OP-AMP 34184 TSSOP	419383-001	1
84	RES SM CHIP 0.2 5% 0.2W	419604-001	1
85	IC SM PWR SPLY MONMAX823	419699-002	1
86	IC SM ADS7809 16 BIT A/D	419952-001	1
87	POST SM 1MM MALE 2X7	420007-007	1
88	FRMWR COMMAND INTERFACE V001A	421920-001	1
89	CKT BD CAM 14 MAIN BD	801281-001	1
90	SCHEM CAM14 MAIN BRD	SD801280-001	0

Drawing notes:

- Unless otherwise specified, all resistors are 10K, 1%; all capacitors are 0.1µF, 10%; all diodes are FDS01503; all ICs are INA126E.
- The bar shown on all polarized capacitors denotes the positive terminal.
- Parts not installed (solder side): R29, R30.
- Trim leads of R224 and R225 in the indicated area so they do not extend beyond edge of solder pad.



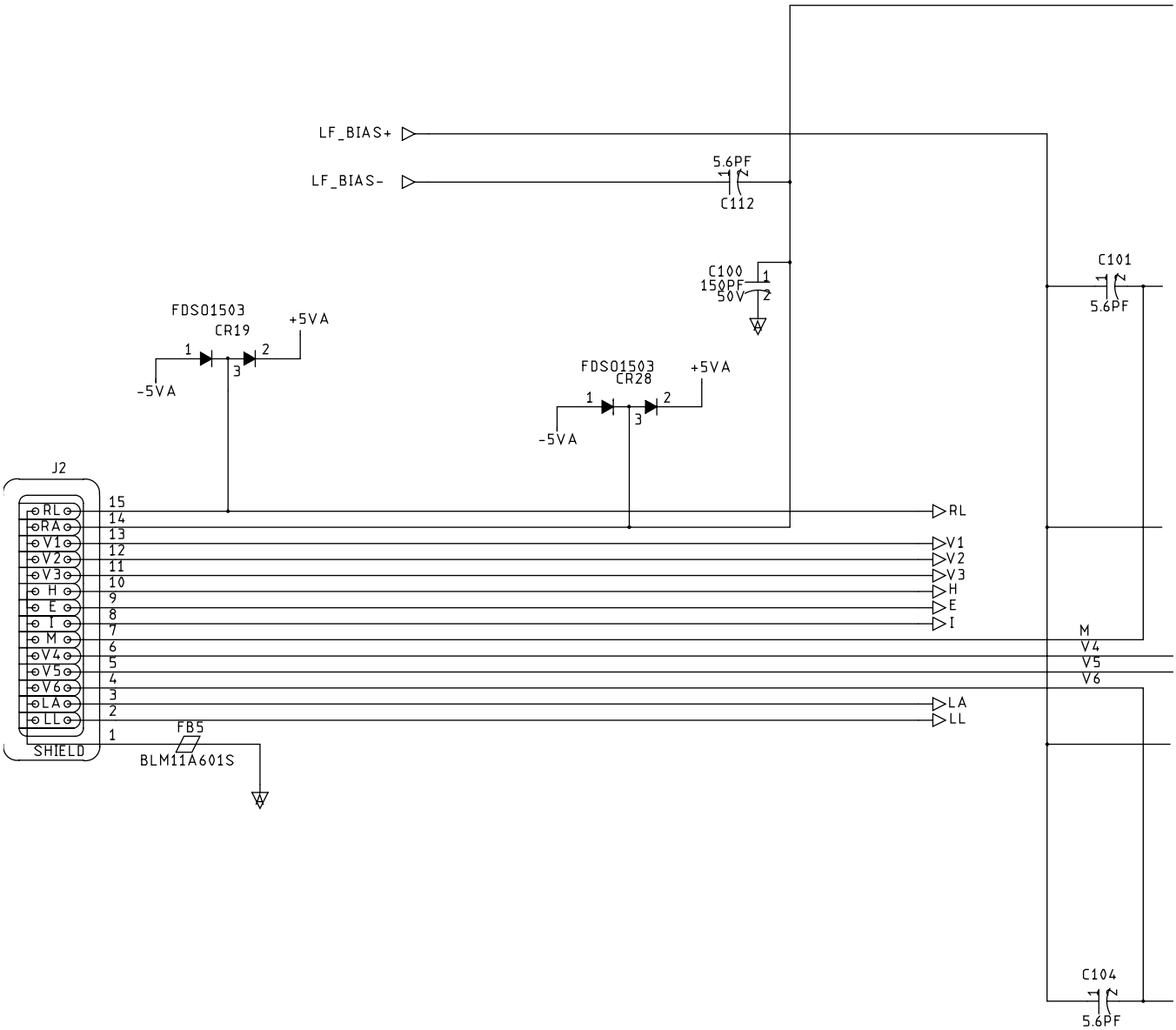
Component (Top) View

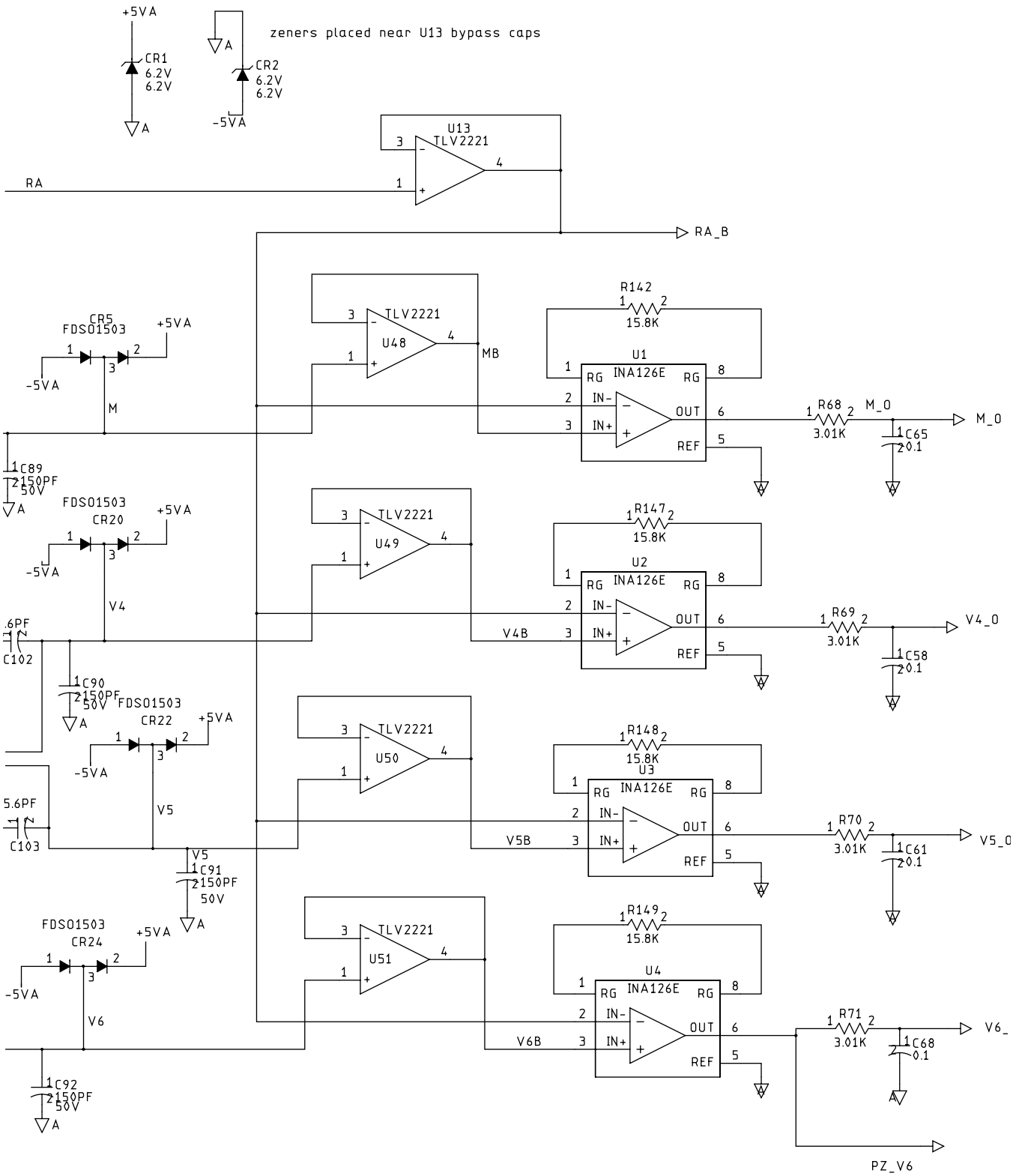


Solder (Bottom) Side

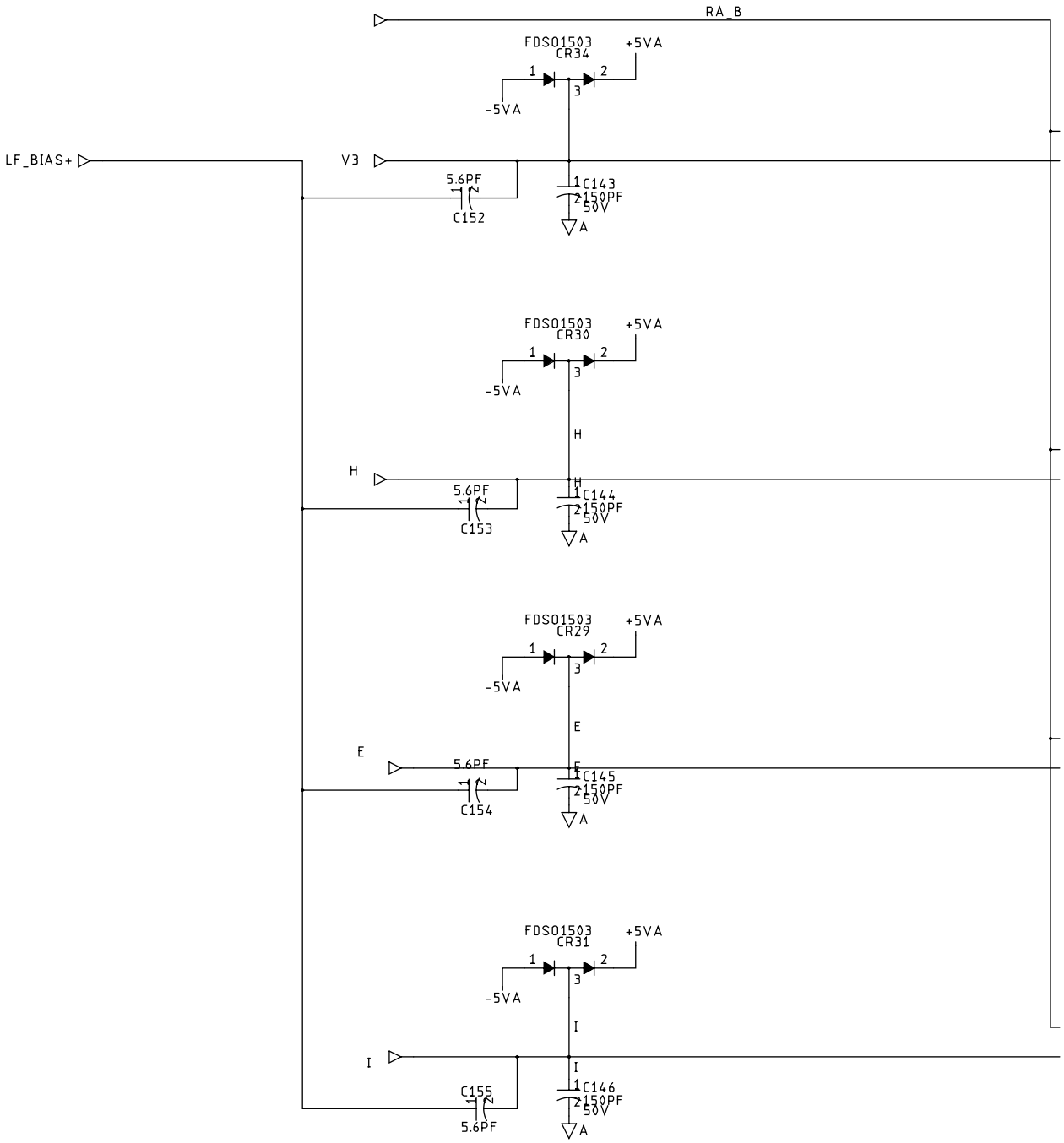
SD8001280-001A Schematic, Main Board

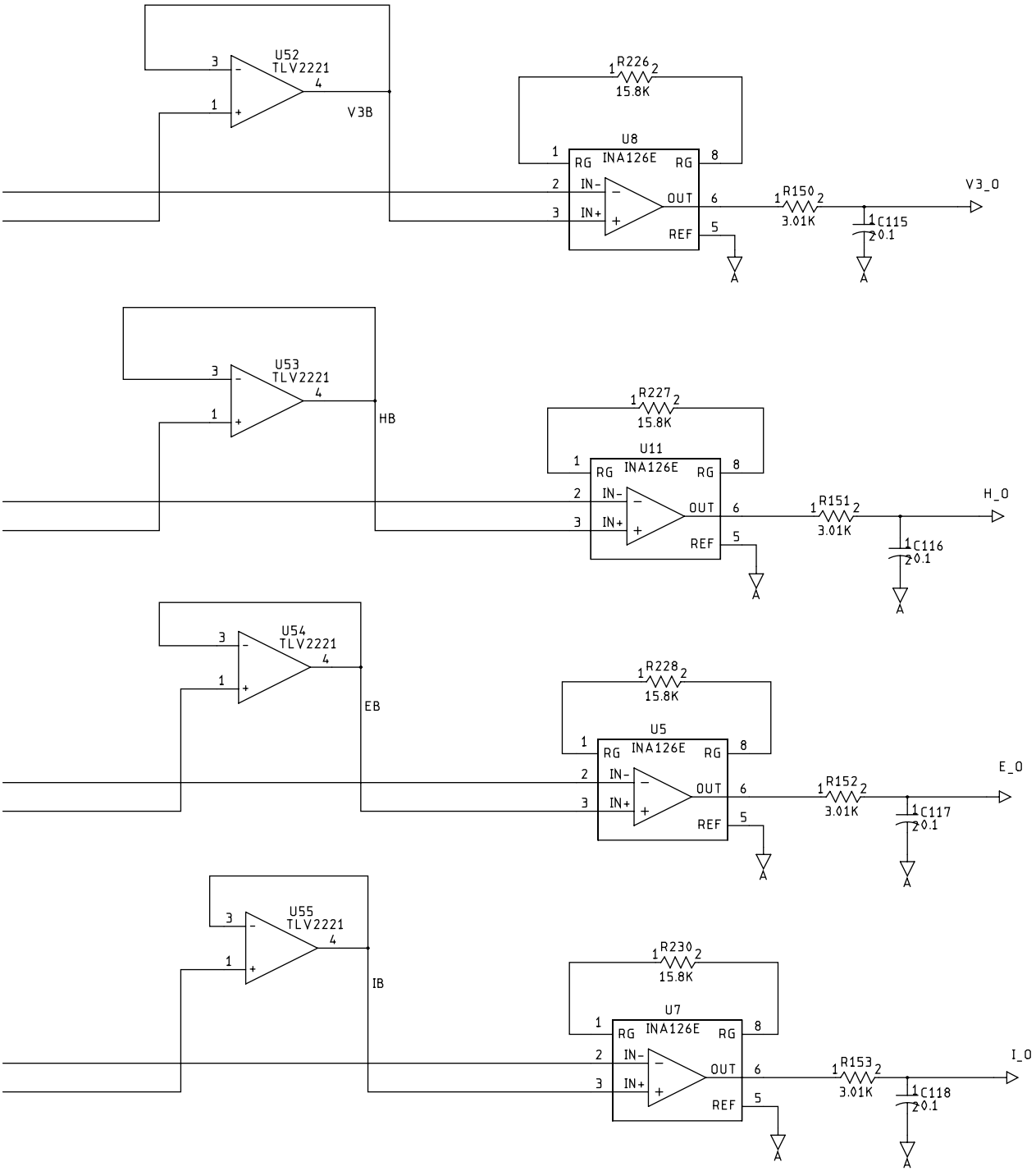
1 of 13



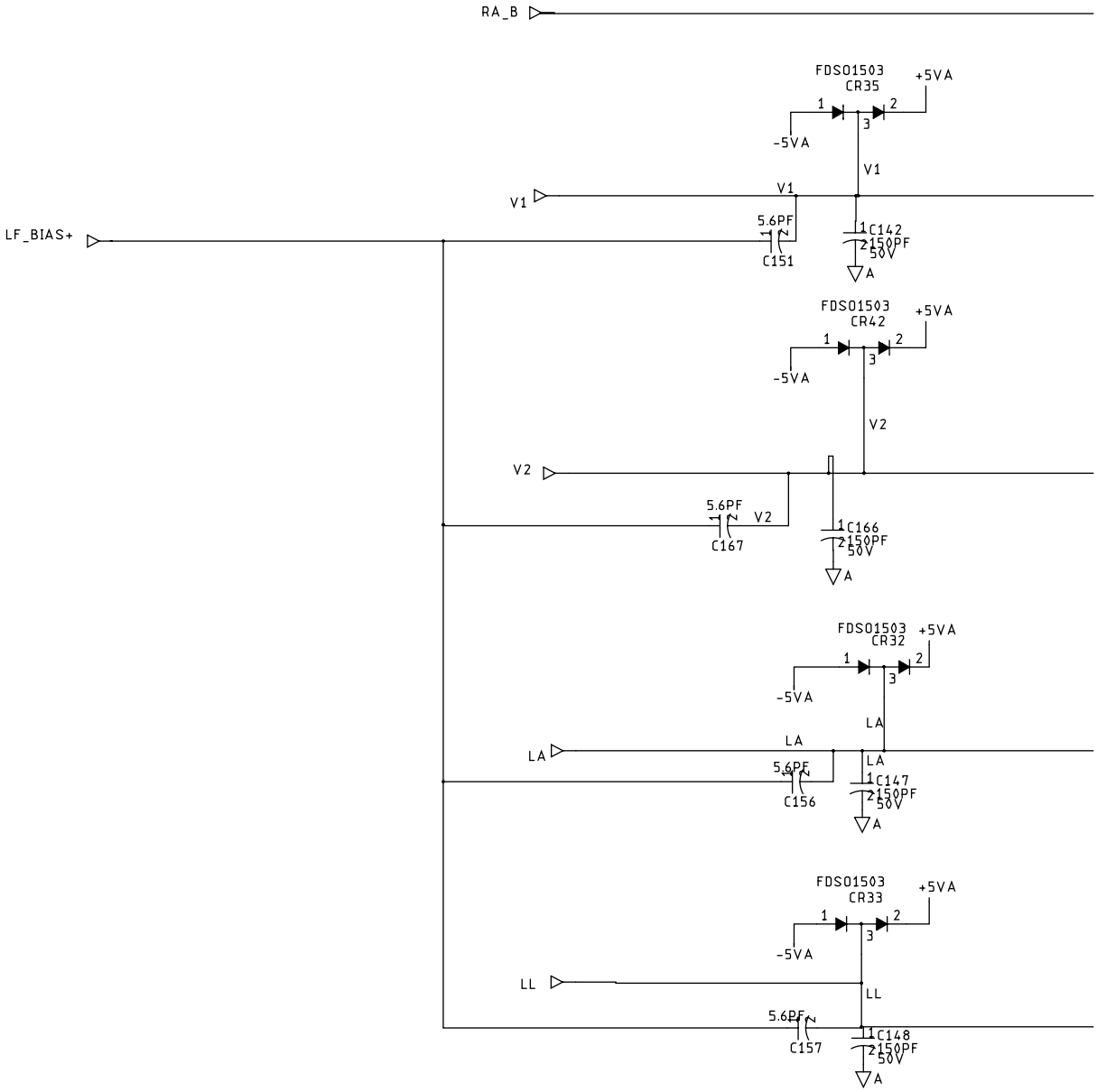

+5VA
CR1
6.2V
6.2V
A
zeners placed near U13 bypass caps
A
CR2
6.2V
6.2V
-5VA
U13
TLV2221
RA
RA_B
CR5
FDS01503
+5VA
-5VA
M
C89
2150PF
50V
A
U48
TLV2221
MB
R142
15.8K
U1
INA126E
RG
IN-
IN+
OUT
REF
R68
3.01K
M_O
C65
0.1
FDS01503
CR20
+5VA
-5VA
V4
C102
C90
2150PF
50V
U49
TLV2221
R147
15.8K
U2
INA126E
V4B
R69
3.01K
V4_O
C58
0.1
FDS01503
CR22
+5VA
-5VA
V5
C103
C91
2150PF
50V
U50
TLV2221
R148
15.8K
U3
INA126E
V5B
R70
3.01K
V5_O
C61
0.1
FDS01503
CR24
+5VA
-5VA
V6
C92
2150PF
50V
U51
TLV2221
R149
15.8K
U4
INA126E
V6B
R71
3.01K
V6_
C68
0.1
PZ_V6

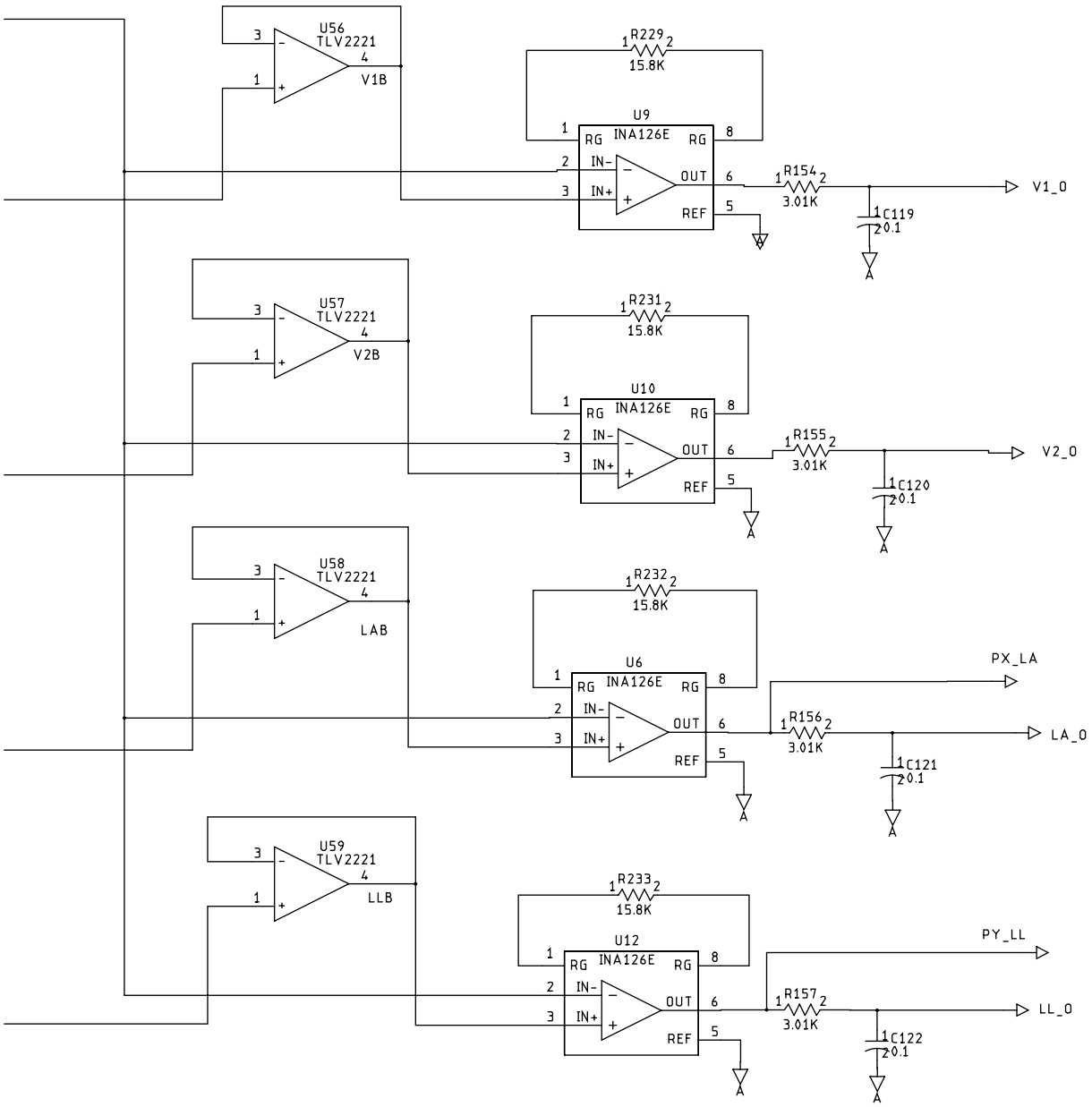
2 of 13


RA_B
FDSO1503
CR34
+5VA
-5VA
LF_BIAS+
V3
5.6PF
C152
C143
150PF
50V
A
FDSO1503
CR30
+5VA
-5VA
H
H
5.6PF
C153
C144
150PF
50V
A
FDSO1503
CR29
+5VA
-5VA
E
E
5.6PF
C154
C145
150PF
50V
A
FDSO1503
CR31
+5VA
-5VA
I
I
C155
5.6PF
C146
150PF
50V
A


U52
TLV2221
V3B
R226
15.8K
U8
INA126E
RG
IN-
IN+
OUT
REF
R150
3.01K
C115
0.1
V3_O
U53
TLV2221
HB
R227
15.8K
U11
INA126E
R151
3.01K
C116
0.1
H_O
U54
TLV2221
EB
R228
15.8K
U5
INA126E
R152
3.01K
C117
0.1
E_O
U55
TLV2221
IB
R230
15.8K
U7
INA126E
R153
3.01K
C118
0.1
I_O

3 of 13


RA_B
FDS01503
CR35
+5VA
-5VA
V1
V1
V1
LF_BIAS+
5.6PF
C151
C142
2150PF
50V
A
FDS01503
CR42
+5VA
-5VA
V2
V2
V2
5.6PF
C167
C166
2150PF
50V
A
FDS01503
CR32
+5VA
-5VA
LA
LA
LA
5.6PF
C156
C147
2150PF
50V
A
FDS01503
CR33
+5VA
-5VA
LL
LL
5.6PF
C157
C148
2150PF
50V
A


U56
TLV2221
V1B
R229
15.8K
U9
INA126E
RG
IN-
IN+
OUT
REF
R154
3.01K
C119
0.1
V1_O
U57
TLV2221
V2B
R231
15.8K
U10
INA126E
R155
3.01K
C120
0.1
V2_O
U58
TLV2221
LAB
R232
15.8K
U6
INA126E
PX_LA
R156
3.01K
C121
0.1
LA_O
U59
TLV2221
LLB
R233
15.8K
U12
INA126E
PY_LL
R157
3.01K
C122
0.1
LL_O

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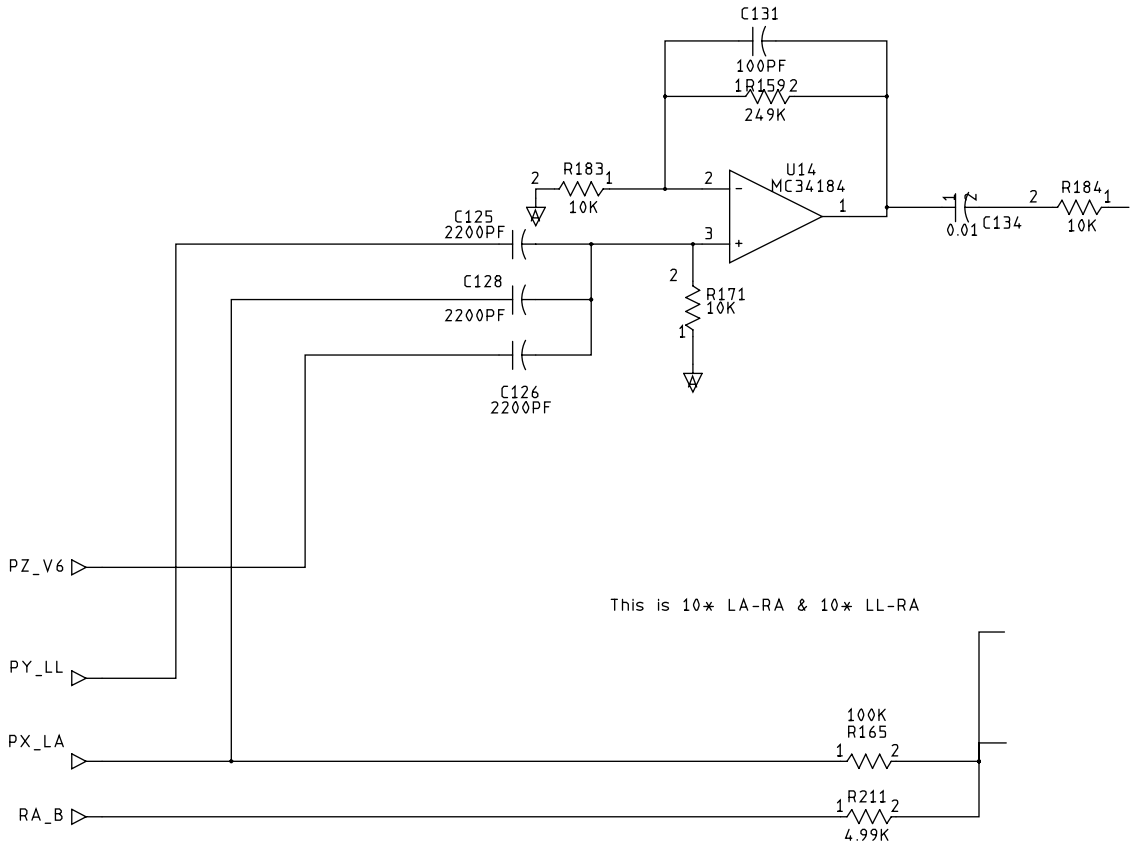
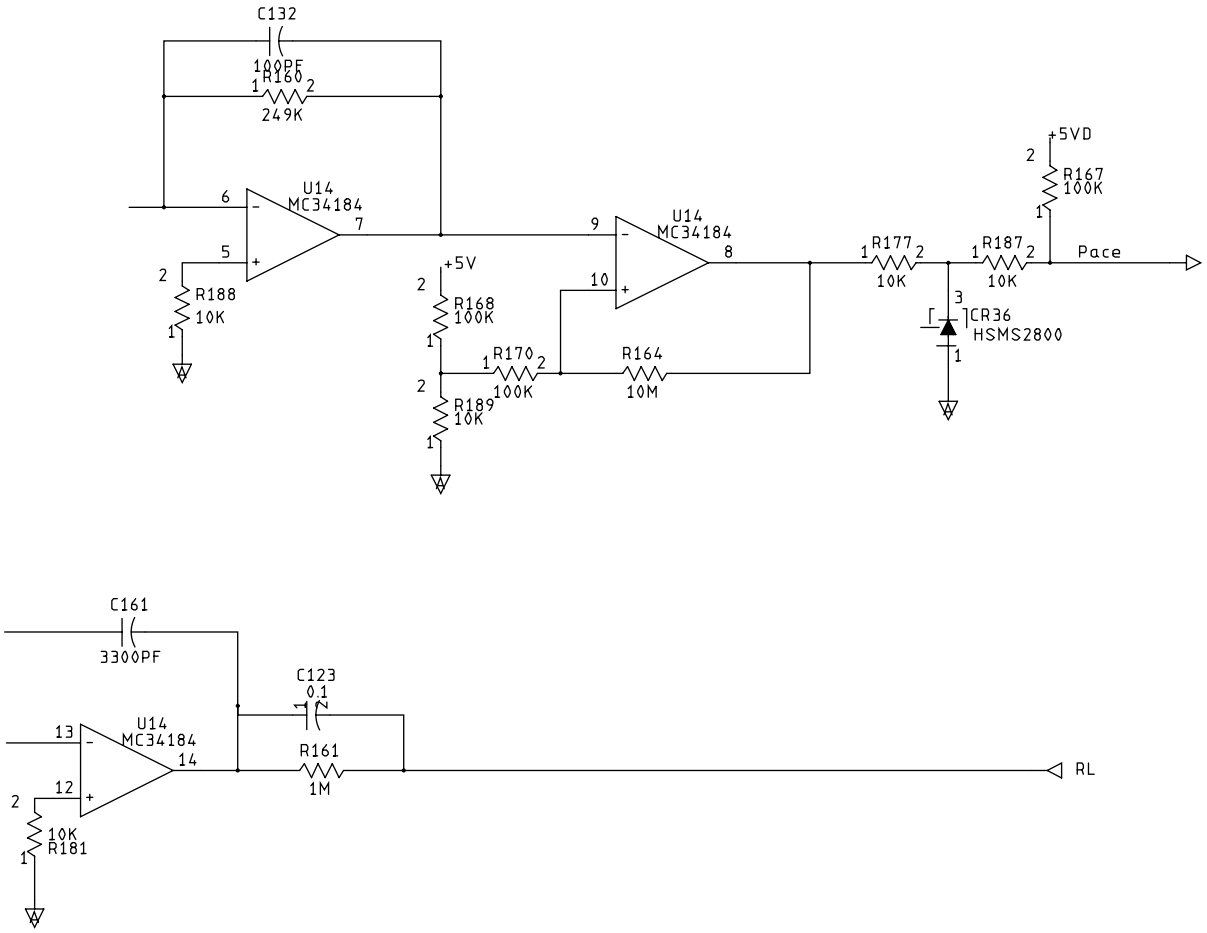

C131
100PF
1R1592
249K
R183
10K
U14
MC34184
C125
2200PF
C128
2200PF
C126
2200PF
R171
10K
C134
0.01
R184
10K
PZ_V6
PY_LL
PX_LA
RA_B
This is 10* LA-RA & 10* LL-RA
100K
R165
R211
4.99K


C132
100PF
R160
249K
U14
MC34184
R188
10K
+5V
R168
100K
R170
100K
R189
10K
R164
10M
+5VD
R167
100K
R177
10K
R187
10K
Pace
CR36
HSMS2800
C161
3300PF
C123
0.1
U14
MC34184
R161
1M
RL
R181
10K

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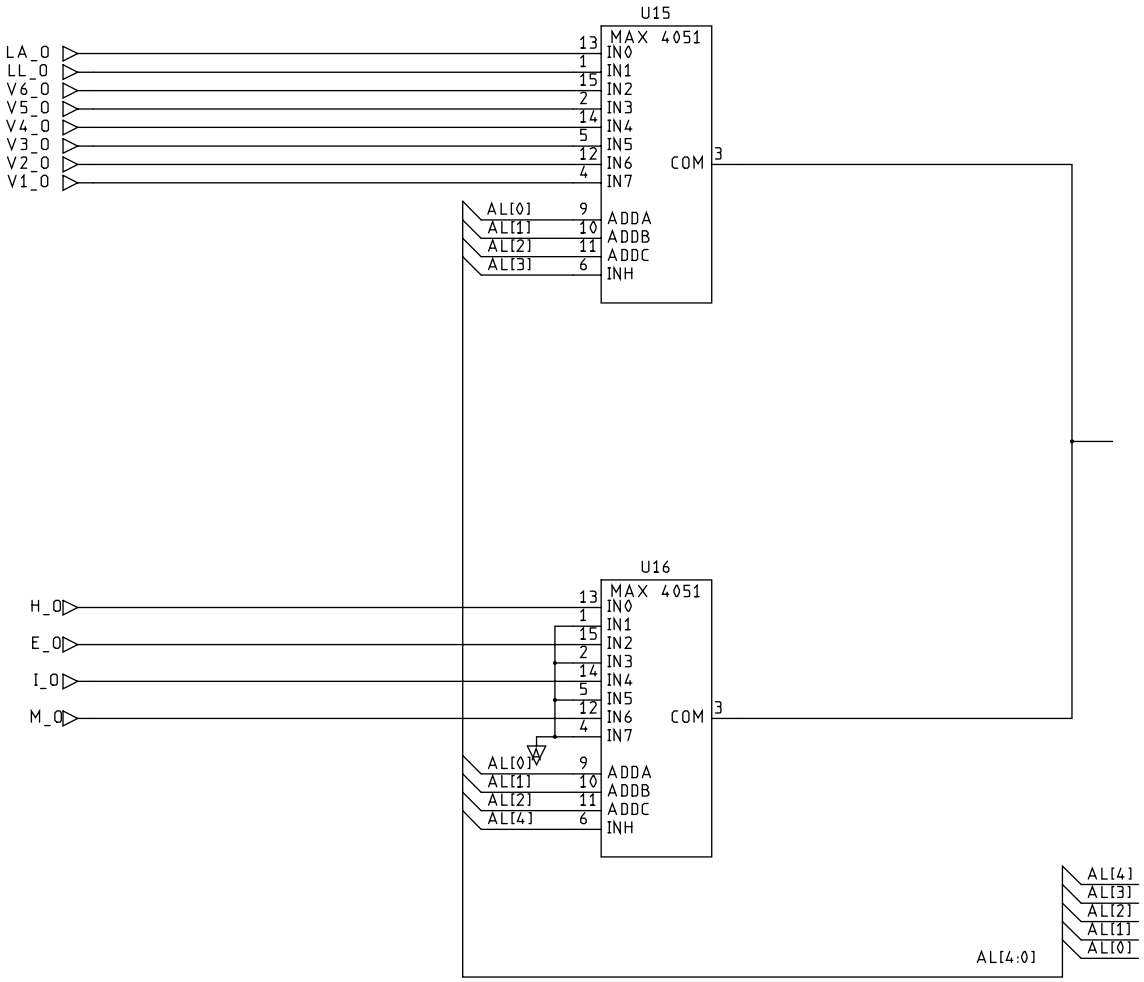
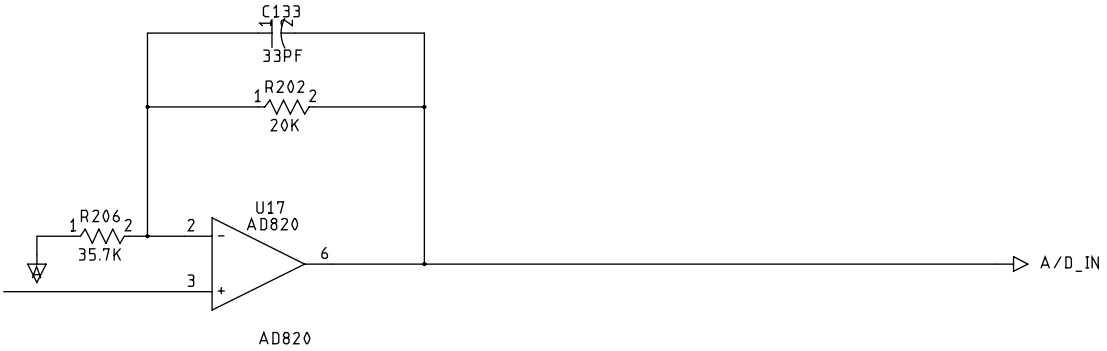
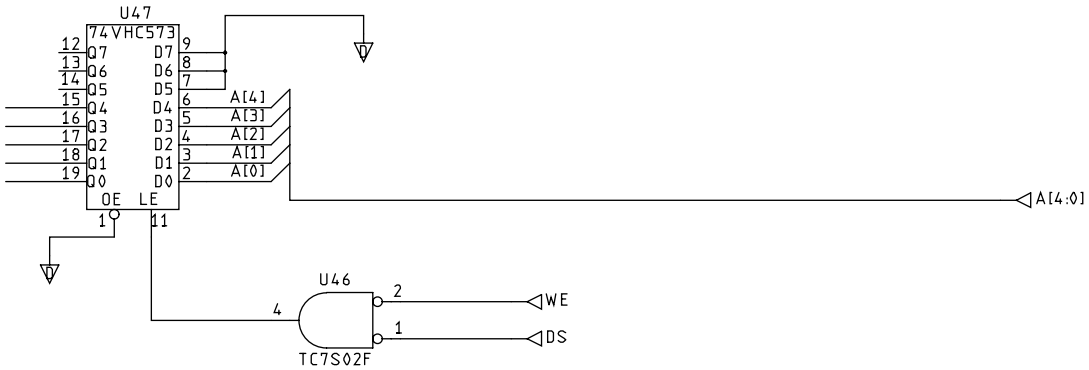

U15
MAX 4051
LA_O
LL_O
V6_O
V5_O
V4_O
V3_O
V2_O
V1_O
13
1
15
2
14
5
12
4
IN0
IN1
IN2
IN3
IN4
IN5
IN6
IN7
COM
3
AL[0]
AL[1]
AL[2]
AL[3]
9
10
11
6
ADDA
ADDB
ADDC
INH
U16
MAX 4051
H_O
E_O
I_O
M_O
AL[0]
AL[1]
AL[2]
AL[4]
AL[4]
AL[3]
AL[2]
AL[1]
AL[0]
AL[4:0]





U47	74VHC573	20	+5VD	10	D
C171	0.1	+5VD	D		

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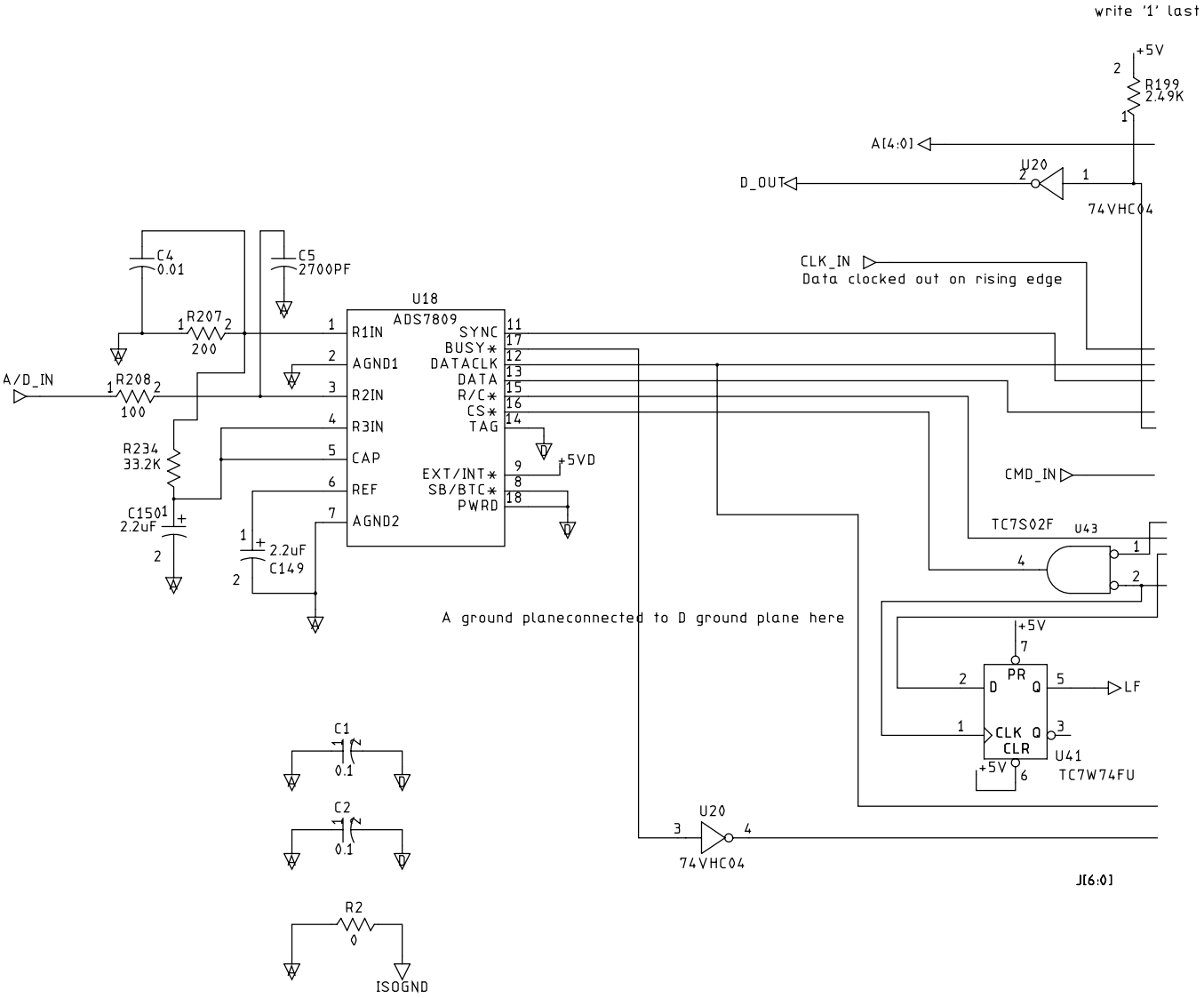
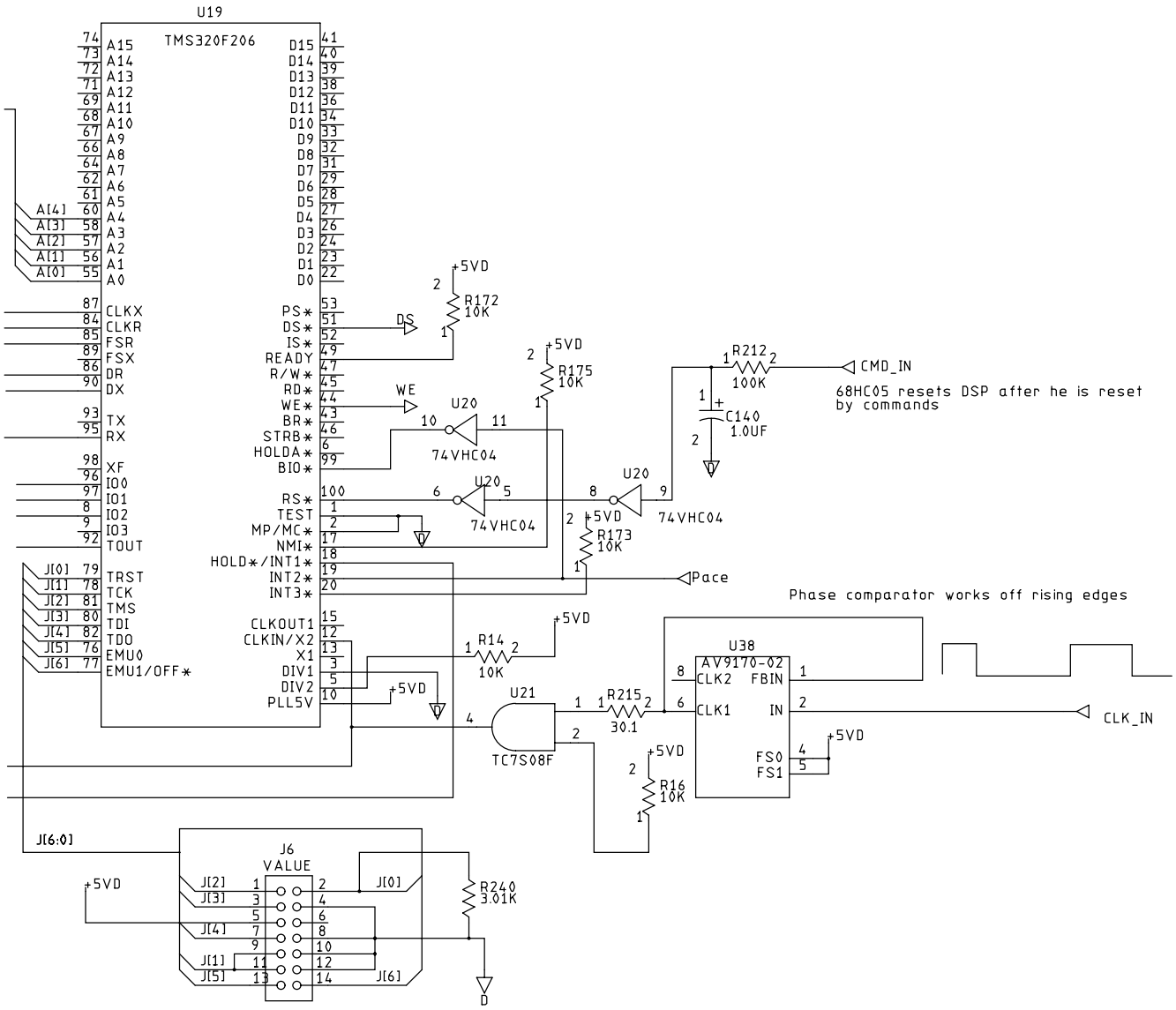

write '1' last
+5V
R199
2.49K
A[4:0]
D_OUT
U20
74VHC04
CLK_IN
Data clocked out on rising edge
C4
0.01
C5
2700PF
U18
ADS7809
R207
200
A/D_IN
R208
100
R234
33.2K
C150
2.2uF
C149
2.2uF
R1IN
AGND1
R2IN
R3IN
CAP
REF
AGND2
SYNC
BUSY*
DATACLK
DATA
R/C*
CS*
TAG
EXT/INT*
SB/BTC*
PWRD
+5VD
CMD_IN
TC7S02F
U43
A ground planeconnected to D ground plane here
PR
D
Q
CLK
CLR
LF
U41
TC7W74FU
C1
0.1
C2
0.1
R2
0
ISOGND
J[6:0]


U19
TMS320F206
A15
A14
A13
A12
A11
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
A[4]
A[3]
A[2]
A[1]
A[0]
D15
D14
D13
D12
D11
D10
D9
D8
D7
D6
D5
D4
D3
D2
D1
D0
CLKX
CLKR
FSR
FSX
DR
DX
TX
RX
XF
IO0
IO1
IO2
IO3
TOUT
TRST
TCK
TMS
TDI
TDO
EMU0
EMU1/OFF*
J[0]
J[1]
J[2]
J[3]
J[4]
J[5]
J[6]
PS*
DS*
IS*
READY
R/W*
RD*
WE*
BR*
STRB*
HOLDA*
BIO*
RS*
TEST
MP/MC*
NMI*
HOLD*/INT1*
INT2*
INT3*
CLKOUT1
CLKIN/X2
X1
DIV1
DIV2
PLL5V
+5VD
R172
10K
DS
WE
U20
74VHC04
R175
10K
R212
100K
CMD_IN
68HC05 resets DSP after he is reset
by commands
C140
1.0UF
R173
10K
Pace
Phase comparator works off rising edges
R14
10K
U21
TC7S08F
R215
30.1
U38
AV9170-02
CLK2
FBIN
CLK1
IN
FS0
FS1
CLK_IN
R16
10K
J[6:0]
J6
VALUE
R240
3.01K
D

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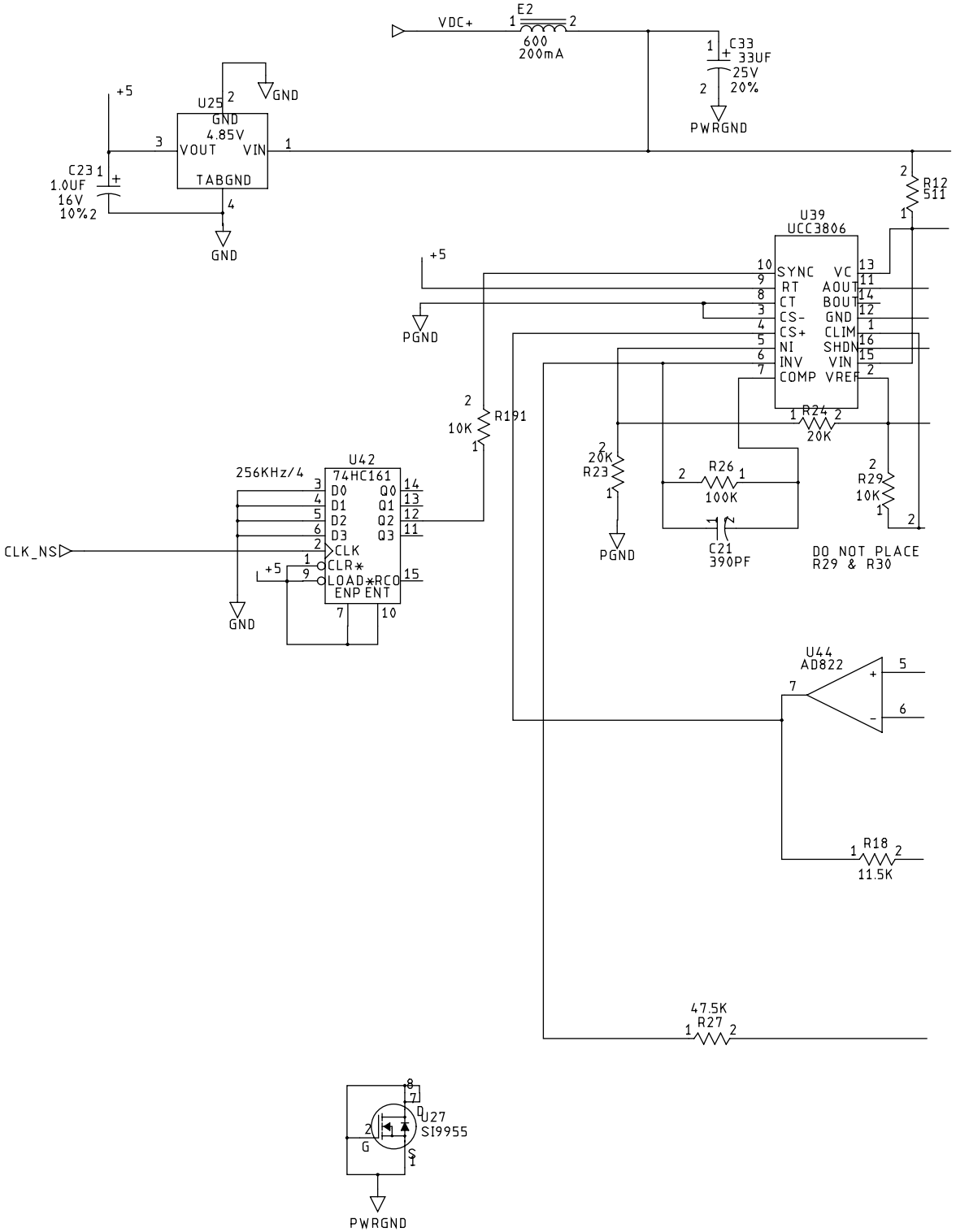
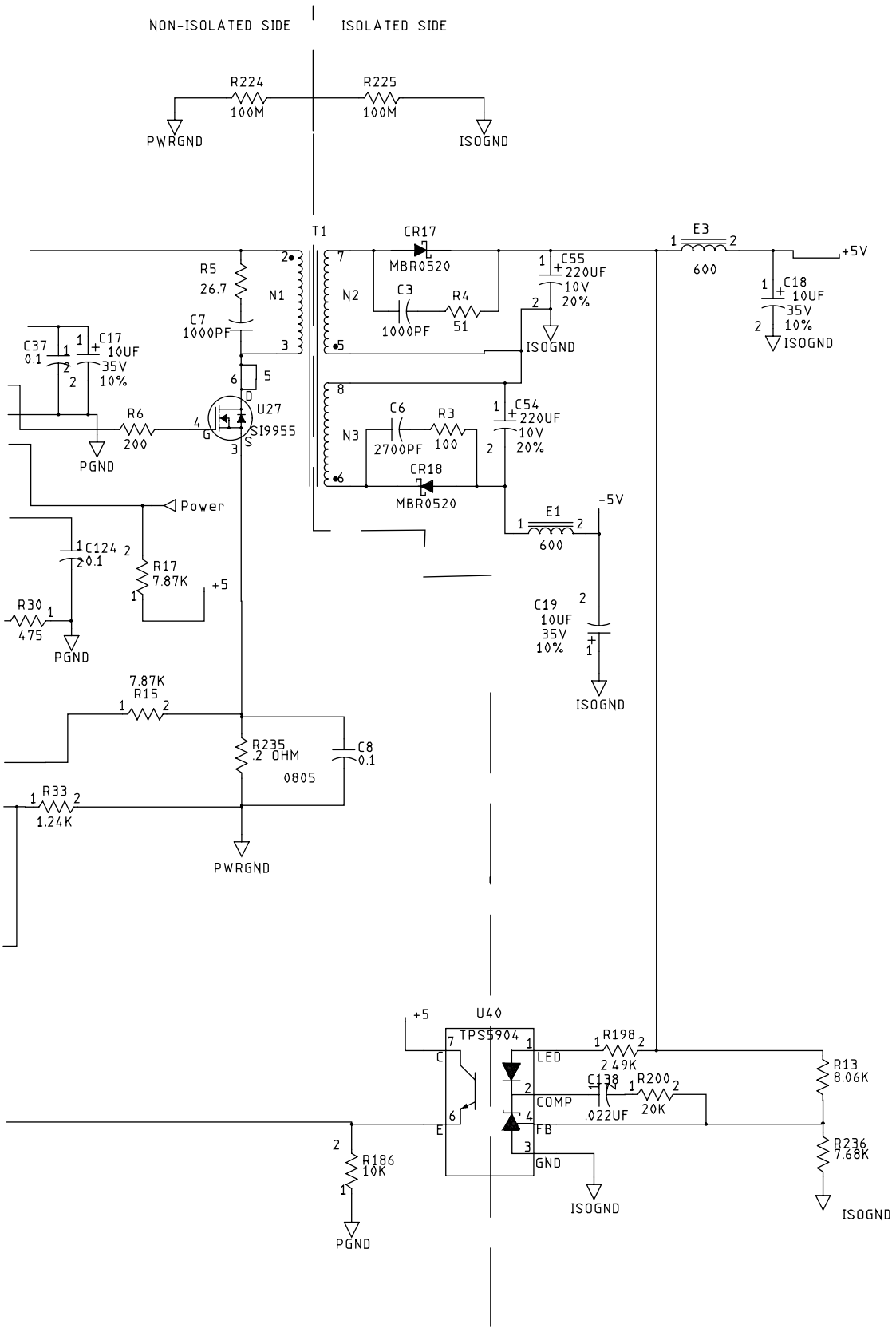

VDC+
E2
600
200mA
C33
33UF
25V
20%
PWRGND
+5
U25
GND
4.85V
VOUT
VIN
TABGND
C23
1.0UF
16V
10%
GND
R12
511
U39
UCC3806
SYNC
RT
CT
CS-
CS+
NI
INV
COMP
VC
AOUT
BOUT
GND
CLIM
SHDN
VIN
VREF
PGND
R191
10K
R24
20K
R23
20K
R26
100K
R29
10K
C21
390PF
DO NOT PLACE
R29 & R30
U42
256KHz/4
74HC161
D0
D1
D2
D3
CLK
CLR*
LOAD*
ENP
ENT
RCO
Q0
Q1
Q2
Q3
CLK_NS
U44
AD822
R18
11.5K
47.5K
R27
U27
SI9955
PWRGND


NON-ISOLATED SIDE
ISOLATED SIDE
R224
100M
R225
100M
PWRGND
ISOGND
T1
CR17
MBR0520
E3
600
+5V
R5
26.7
N1
N2
C3
1000PF
R4
51
C55
220UF
10V
20%
C18
10UF
35V
10%
C7
1000PF
C37
0.1
C17
10UF
35V
10%
U27
SI9955
R6
200
PGND
N3
C6
2700PF
R3
100
C54
220UF
10V
20%
CR18
MBR0520
E1
600
-5V
Power
C124
0.1
R17
7.87K
+5
R30
475
PGND
C19
10UF
35V
10%
ISOGND
7.87K
R15
R235
.2 OHM
0805
C8
0.1
R33
1.24K
PWRGND
+5
U40
TPS5904
LED
COMP
FB
GND
R198
2.49K
C138
.022UF
R200
20K
R13
8.06K
R236
7.68K
ISOGND
R186
10K
PGND
ISOGND

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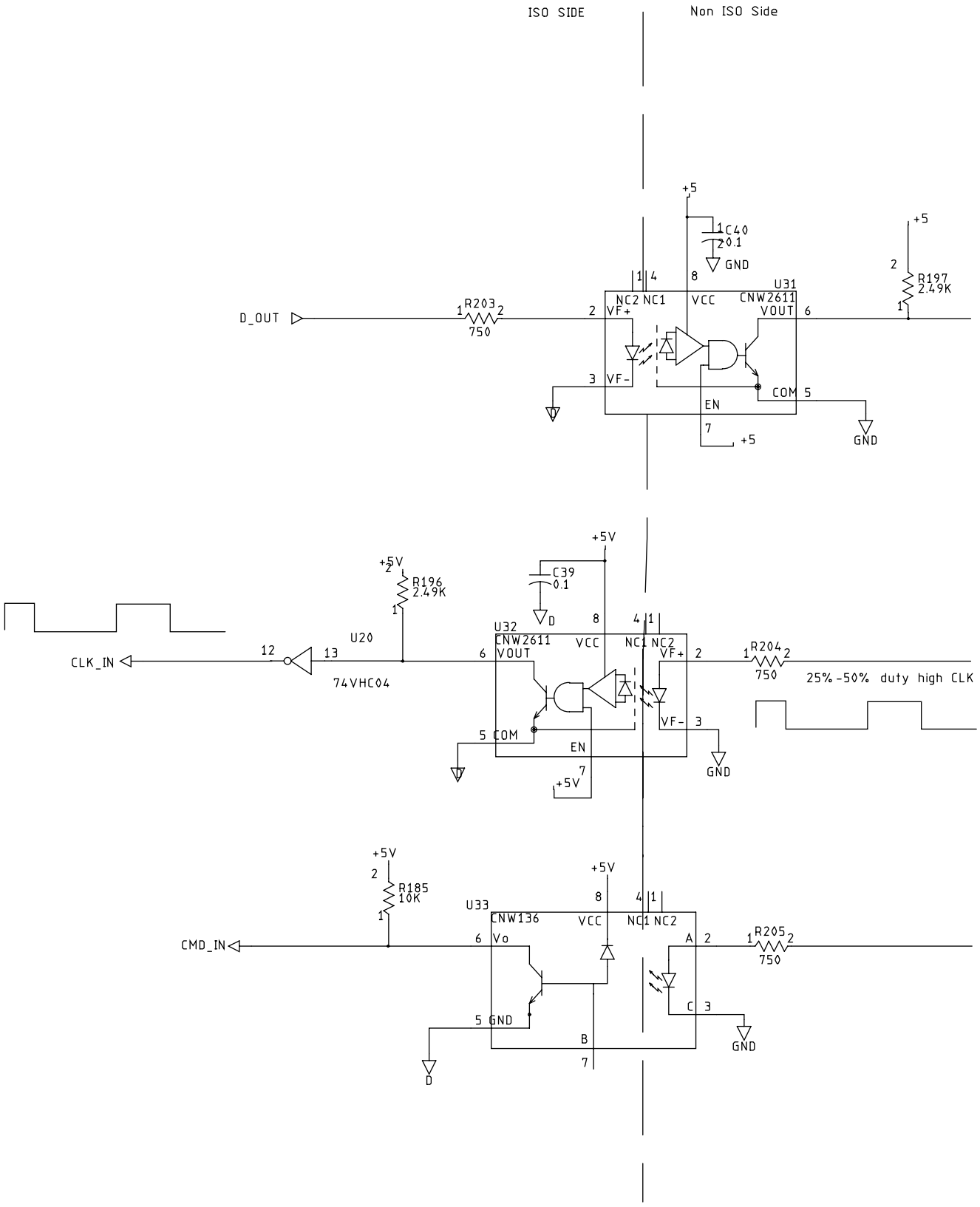
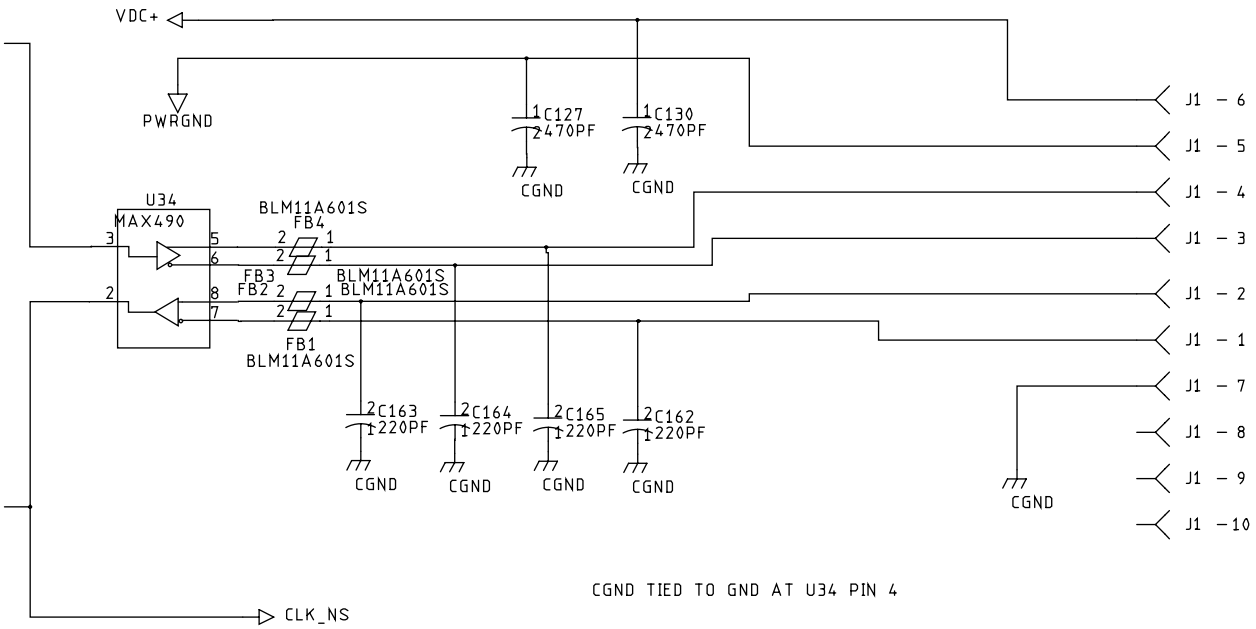
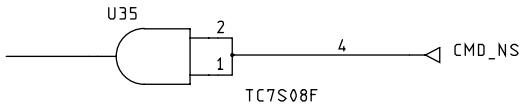

ISO SIDE
Non ISO Side
+5
C40
0.1
GND
U31
CNW2611
NC2 NC1 VCC
VF+
VOUT
VF-
COM
EN
R203
750
D_OUT
R197
2.49K
+5
GND
+5V
C39
0.1
U32
CNW2611
R196
2.49K
U20
74VHC04
CLK_IN
R204
750
25% -50% duty high CLK
+5V
R185
10K
U33
CNW136
Vo
GND
R205
750
CMD_IN


VDC+
PWRGND
C127
470PF
C130
470PF
CGND
CGND
J1 – 6
J1 – 5
J1 – 4
J1 – 3
J1 – 2
J1 – 1
J1 – 7
J1 – 8
J1 – 9
J1 – 10
U34
MAX490
BLM11A601S
FB4
FB3
FB2
FB1
BLM11A601S
BLM11A601S
BLM11A601S
C163
220PF
C164
220PF
C165
220PF
C162
220PF
CGND
CGND
CGND
CGND
CGND
CGND TIED TO GND AT U34 PIN 4
CLK_NS


U35
CMD_NS
TC7S08F

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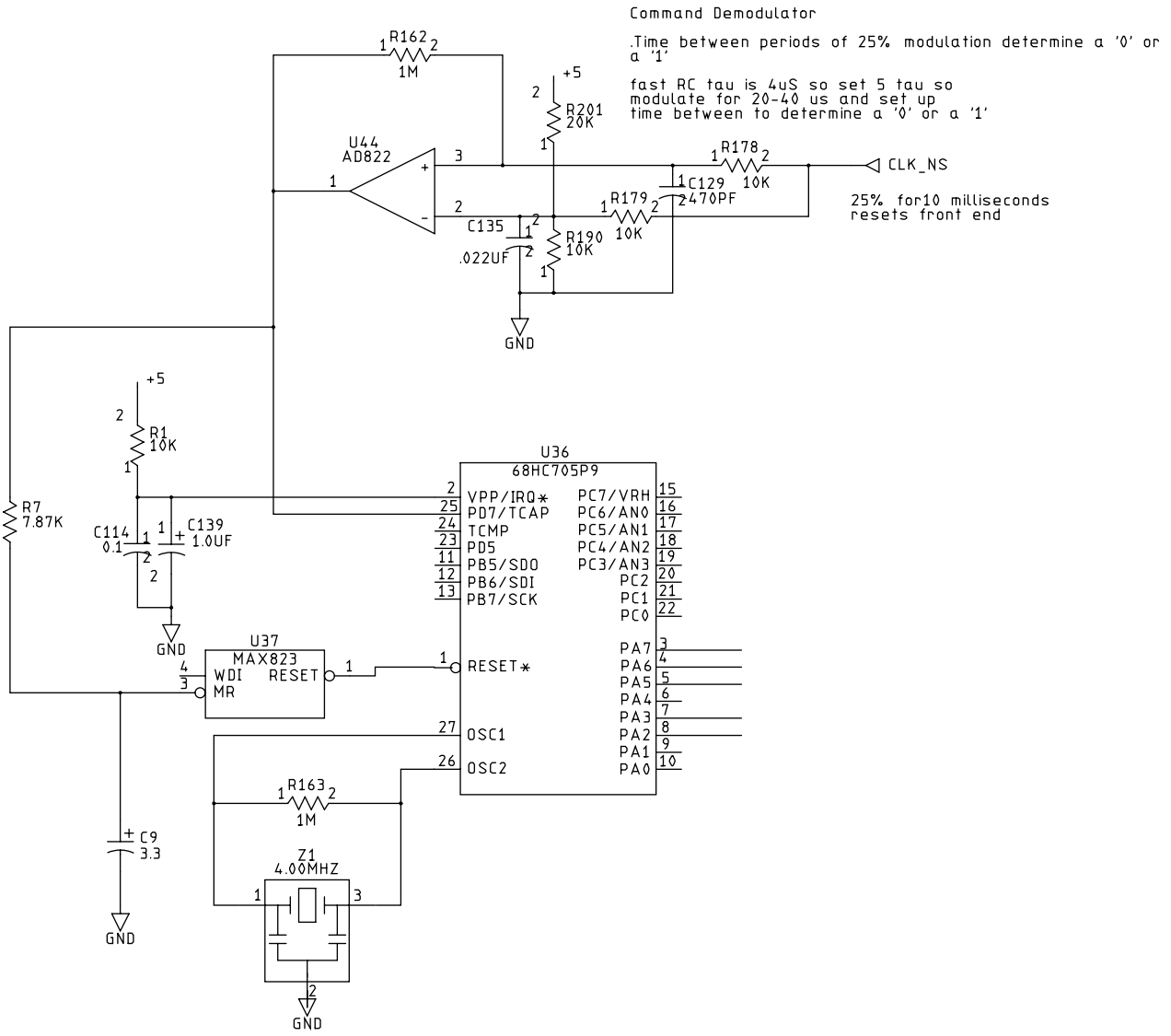
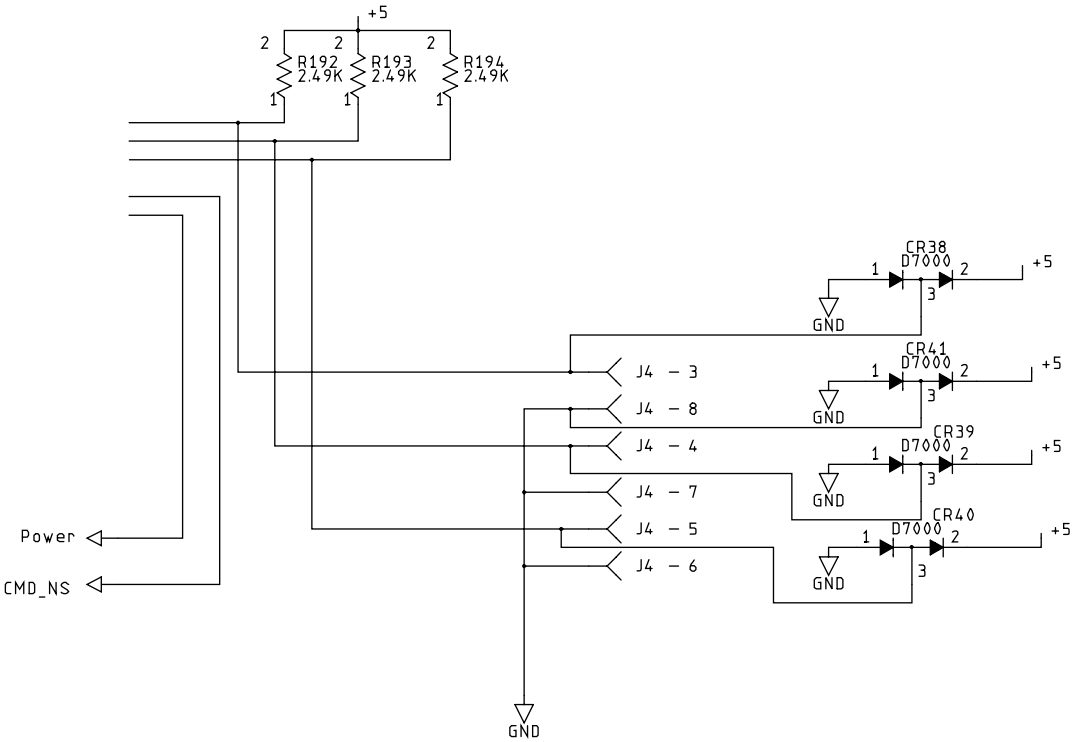

Command Demodulator
.Time between periods of 25% modulation determine a '0' or a '1'
fast RC tau is 4uS so set 5 tau so modulate for 20-40 us and set up time between to determine a '0' or a '1'
R162
1M
+5
R201
20K
U44
AD822
R178
10K
CLK_NS
C129
470PF
R179
10K
25% for10 milliseconds resets front end
C135
.022UF
R190
10K
GND
R1
10K
R7
7.87K
C114
0.1
C139
1.0UF
U36
68HC705P9
VPP/IRQ*
PD7/TCAP
TCMP
PD5
PB5/SDO
PB6/SDI
PB7/SCK
PC7/VRH
PC6/AN0
PC5/AN1
PC4/AN2
PC3/AN3
PC2
PC1
PC0
PA7
PA6
PA5
PA4
PA3
PA2
PA1
PA0
RESET*
OSC1
OSC2
U37
MAX823
WDI
MR
RESET
R163
1M
C9
3.3
Z1
4.00MHZ


+5
R192
2.49K
R193
2.49K
R194
2.49K
CR38
D7000
CR41
D7000
CR39
D7000
CR40
D7000
GND
J4 – 3
J4 – 8
J4 – 4
J4 – 7
J4 – 5
J4 – 6
Power
CMD_NS

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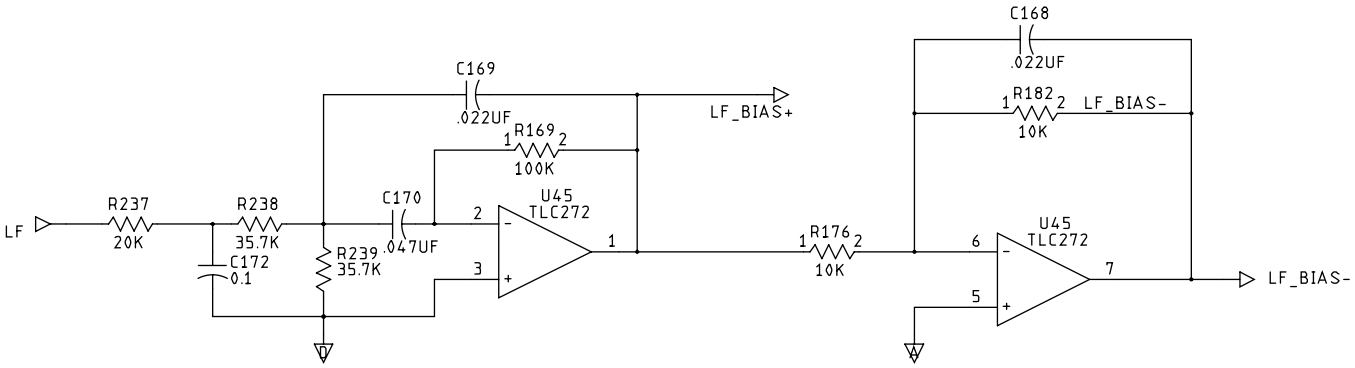

D ground plane tie to A ground plane here

U45	TLC272			8		+5VA		4		-5VA	
BC2	0.1	2	+5VA		1	A					
BC1	0.1	2	-5VA		1	A					

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U1	INA126E		4	-5VA	
			7	+5VA	
BC3	0.1	+5VA	A		
BC4	0.1	-5VA	A		

U2	INA126E		4	-5VA	
			7	+5VA	
BC5	0.1	+5VA	A		
BC6	0.1	-5VA	A		

U3	INA126E		4	-5VA	
			7	+5VA	
BC7	0.1	+5VA	A		
BC8	0.1	-5VA	A		

U4	INA126E		4	-5VA	
			7	+5VA	
BC9	0.1	+5VA	A		
BC10	0.1	-5VA	A		

U5	INA126E		4	-5VA	
			7	+5VA	
BC11	0.1	+5VA	A		
BC12	0.1	-5VA	A		

U6	INA126E		4	-5VA	
			7	+5VA	
BC13	0.1	+5VA	A		
BC14	0.1	-5VA	A		

U7	INA126E		4	-5VA	
			7	+5VA	
BC15	0.1	+5VA	A		
BC16	0.1	-5VA	A		

U8	INA126E		4	-5VA	
			7	+5VA	
BC17	0.1	+5VA	A		
BC18	0.1	-5VA	A		

U9	INA126E		4	-5VA	
			7	+5VA	
BC19	0.1	+5VA	A		
BC20	0.1	-5VA	A		

U10	INA126E		4	-5VA	
			7	+5VA	
BC21	0.1	+5VA	A		
BC22	0.1	-5VA	A		

U11	INA126E			4		-5VA					
				7		+5VA					
BC25	0.1	+5VA		A							
BC26	0.1	-5VA		A							

U12	INA126E			4		-5VA					
				7		+5VA					
BC27	0.1	+5VA		A							
BC28	0.1	-5VA		A							

U13	TLV2221			5		+5VA		2		-5VA	
BC45	0.1	-5VA		A							
BC46	0.1	+5VA		A							

U17	AD820			7		+5VA		4		-5VA	
BC47	0.1	+5VA		A							
BC48	0.1	-5VA		A							

U41	TC7W74FU			8		+5VD		4		D	
BC49	0.1	+5VD		D							

U38	AV9170-02			7		+5VD		3		D	
BC50	0.1	+5VD		D							

U19	TMS320F206			11 16 4 7		+5VD		21 25 30 14		D	
				35 50 63 75		+5VD		37 42 48 54		D	
				91		+5VD		59 65 70 83		D	
								88 94		D	
BC51	0.1	+5VD		D		BC58	0.1	+5VD		D	
BC52	0.1	+5VD		D		BC59	0.1	+5VD		D	
BC53	0.1	+5VD		D							
BC54	0.1	+5VD		D							
BC55	0.1	+5VD		D							
BC56	0.1	+5VD		D							
BC57	0.1	+5VD		D							

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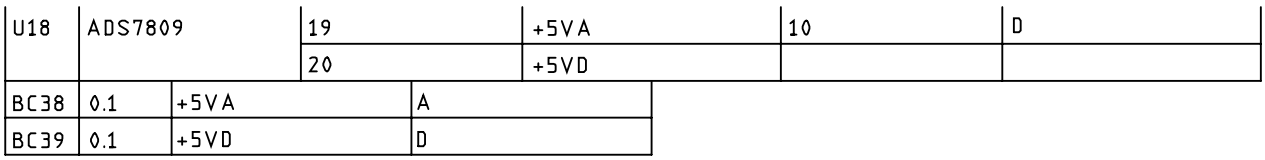
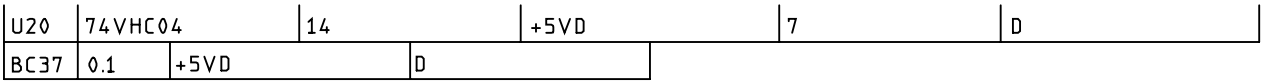
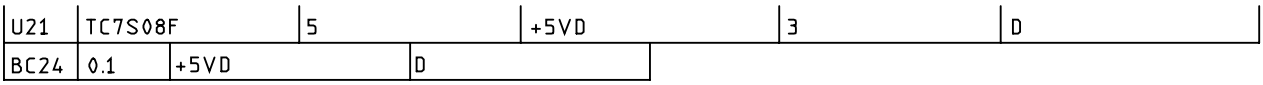
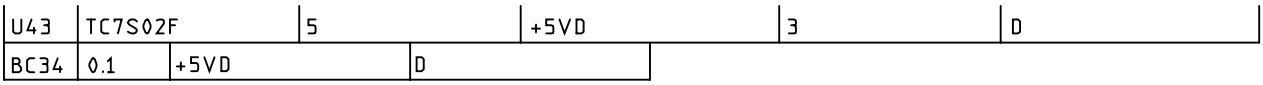
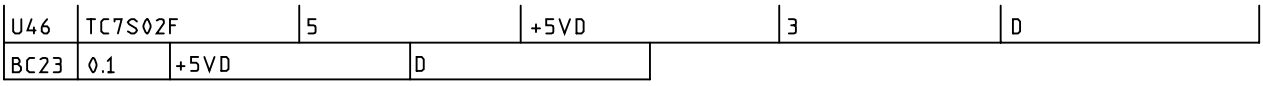

U18 ADS7809 19 +5VA 10 D
20 +5VD
BC38 0.1 +5VA A
BC39 0.1 +5VD D


U20 74VHC04 14 +5VD 7 D
BC37 0.1 +5VD D


U21 TC7S08F 5 +5VD 3 D
BC24 0.1 +5VD D


U43 TC7S02F 5 +5VD 3 D
BC34 0.1 +5VD D


U46 TC7S02F 5 +5VD 3 D
BC23 0.1 +5VD D

U14	MC34184	11	-5VA	4	+5VA

BC36	0.1	-5VA	A
BC35	0.1	+5VA	A

U15	MAX 4051	16	+5VA	8	A
		7	-5VA		

BC29	0.1	+5VA	A
BC30	0.1	-5VA	A

U16	MAX 4051	16	+5VA	8	A
		7	-5VA		

BC31	0.1	+5VA	A
BC32	0.1	-5VA	A

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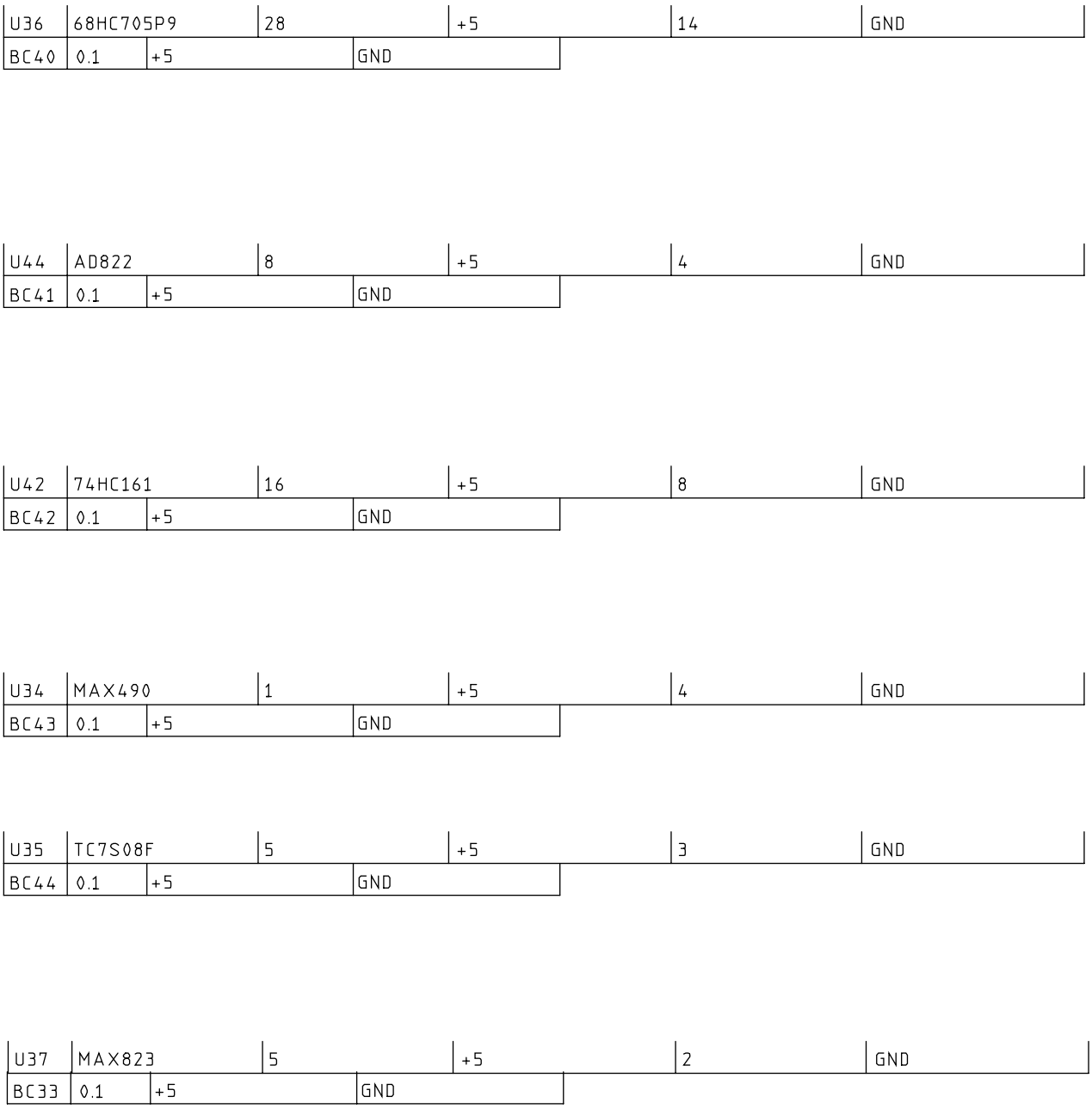
U36 68HC705P9 28 +5 14 GND
BC40 0.1 +5 GND
U44 AD822 8 +5 4 GND
BC41 0.1 +5 GND
U42 74HC161 16 +5 8 GND
BC42 0.1 +5 GND
U34 MAX490 1 +5 4 GND
BC43 0.1 +5 GND
U35 TC7S08F 5 +5 3 GND
BC44 0.1 +5 GND
U37 MAX823 5 +5 2 GND
BC33 0.1 +5 GND

U48	TLV2221	5	+5VA	2	-5VA
U49	TLV2221	5	+5VA	2	-5VA
U50	TLV2221	5	+5VA	2	-5VA
U51	TLV2221	5	+5VA	2	-5VA
U52	TLV2221	5	+5VA	2	-5VA
U53	TLV2221	5	+5VA	2	-5VA
U54	TLV2221	5	+5VA	2	-5VA
U55	TLV2221	5	+5VA	2	-5VA
U56	TLV2221	5	+5VA	2	-5VA
U57	TLV2221	5	+5VA	2	-5VA
U58	TLV2221	5	+5VA	2	-5VA
U59	TLV2221	5	+5VA	2	-5VA

Appendix A: Abbreviations

Standard Abbreviations 3

Standard Abbreviations

A

A	ampere
A-ang	antianginal
A-arh	antiarrhythmic
A-coa	anticoagulants
A-hyp	antihypertensive
A1 - A4	auxiliary leadwires
AAMI	American Association of Medical Instrumentation
ABP	ambulatory blood pressure
ac, AC	alternating current
ACLS	Advanced Cardiac Life Support
A/D	analog-to-digital
Adj	adjustable
AG	automotive glass
Ah	ampere hours
AHA	American Heart Association
Al	aluminum
AllRam	all RAM
AllSec	all sector
AllTrk	all track
ALT	alternate
Alt-Off	alternate offset
am, AM	acquisition module, ante meridiem
AM-1	acquisition module-1
AM-1M	acquisition module-1 modified
AM-2	acquisition module-2
AM-3	acquisition module-3
AM-4	acquisition module-4
amp	ampere
Ampl	amplifier
AMU	ambulatory monitoring unit
ANA	analog
ANLG	analog
AnsrTone	answer tone
A/O	Analog Output
ASCII	American Standard Code for Information Interchange
ASSY	assembly
Attn	attention
AUG	August
AUST	Australian
AUSTRALN	Australian
Auto	automatic
AutoRhym	automatic rhythm
AUX	auxiliary
aVF	augmented left leg lead
avg	average
aVL	augmented left arm lead
aVR	augmented right arm lead
AWG	American Wire Gage

B

Bd	board, baud
BDGH	binding head
BetaB	beta blockers
BKSP	backspace
BLK	black
BLU	blue
Blvd	boulevard
BP	blood pressure
BPM	beats per minute
BRIT	Britain
BRN	brown
BSI	British Standards Institute
Btu	British thermal unit

C

CalcBlk	calcium blockers
CAPOC	Computer Assisted Practice of Cardiology
CASE	Computer Aided System for Exercise
Catoprl	Catopril
Cauc	Caucasian
Cer	ceramic
CFM	cubic feet/minute
CGR	computer graphic record
Ch, CH	channel
C/L	center line
CLK	clock signal
Clonid	Clonidine
cm	centimeter
cm2	square centimeters
Cmd	command number
CMMR	common mode rejection ratio
CMOS	complementary metal-oxide semiconductor
c/o	in care of
COM1	communications port 1
COM2	communications port 2
ComLink	communications link
Comp	composition
Confrmd	confirmed
Cont, CONT	Continental, continued
Coumadn	Coumadin
CPR	cardiopulmonary resuscitation
CPU	central processing unit
CR	diode

CRC	cyclic redundancy check
CRD	cord
crt, CRT	cathode ray tube
CSA	Canadian Standards Association
CTRL	control

D

D/A	digital to analog
DA	damping relay
dac, DAC	digital-to-analog converter
DAN	Danish
Dat/Tim	date/time
dBm	decibel (referenced to 1 milliwatt into 600 ohms)
dc, DC	direct current
DD	double density, day
DDD	Digital Diagnostic Diskette
DEC	Digital Equipment Corporation, December
Del	delete
DEMO	demonstration
DES	designation
DevId	device identification
Diag	diagnostic
Digital	Digitalis
Digitox	Digitoxin
Digox	digoxin
Digoxin	Digoxin-Lanoxin
DIP	dual in-line package
Dirctry	directory
Diurt	diuretics
DOB	date of birth
DOS	disk operating system
DP	diametral pitch
DPST	double-pole, single-throw
DRAM	dynamic RAM
DR/DT	digital recording/digital transmission
DSKTP	desktop
Dysopyr	Dysopyramide

E

E	enable, vector electrode site, vector lead
ecg, Ecg, ECG	electrocardiogram
ECO	Engineering Change Order
EDIC	Electrocardiograph Digital Information Center
EEPROM	electrically erasable programmable ROM
e.g.	for example
EGA	enhanced graphics adapter
EMF	electromotive force
EMI	electromagnetic interference
ENG	English
EOF	end of file
EPIC	Electronic Patient Information Chart
EPLD	electrically programmable logic device
EPROM	eraseable, programmable, read-only memory
ESD	electrostatic discharge
etc, etc.	et cetera
EURO	Europe, European
EXP	Expanded

F

F	fuse, Farad, female
F1-F5	function keys 1 through 5
Fax	facsimile
FCC	Federal Communications Commission
FE	front end
FILH	fillister head
FLH	flat head
FLRAM	flash RAM
FR	French
FrntEnd	front end
FSK	frequency shift keying
ft	foot, feet
Furosem	Furosemide

G

g	gram, acceleration due to gravity
GB	Great Britain
GERM	German, Germany
GND	ground, digital ground (dc common)
GRN	green
GRY	gray

H

H	high, vector electrode site, vector lead
HDLC	high-level data link control
Hex, HEX	hexagon, hexadecimal
HH	hour
HiRes	high-resolution
Hr	hour
Hydral	Hydralazine
Hz	Hertz (cycles per second)

I

I	on, input, vector electrode site
I, II, III	limb leads
II	vector lead
IC	integrated circuit
ID	identification
i.e.	that is
IEC	International Electrotechnical Commission
in	inch
IN	input
inc, inc., INC	incorporated
Info	information

Ins	insert
I/O	input/output
I/P	input
ISA	industry standard architecture
Isosorb	Isosorbide
IT	Italian, Italy

J

JAN	January
JIS	Japan Industrial Standards

K

k, K	kilo, 1000, 1024
Kb, KB	kilobyte
kg, Kg	kilogram
kHz, KHz	kilohertz
kV, KV	kilovolt
Kyb	keyboard

L

L	line
L1	level one
L2	level two
LA	left arm
lb	pound
LCD	liquid crystal display
Lcl Line	local line
Ld Grps	lead groups
LED	light-emitting diode
LH	left hand
Lidoca	Lidocaine
LL	left leg
Loc	location
LocPc	Local MAC PC
LogRetry	log retry
Ltd	limited

M

m	meter
M	megabyte, metric, vector electrode site, vector lead, male
mA	milliamperes
MAC	Microcomputer Augmented Cardiograph
mains voltage	voltage of a supply mains between 2 line conductors of a polyphase system or voltage between the line conductor and the neutral of a single-phase system
max	maximum
Measure	measurements
Med	medications
MEM	memory
MF	metal film
MHz	megahertz
min	minutes, minimum
Misc	miscellaneous
mm	millimeter
MM	minute
MMM	month
mm/mV	millimeter per millivolt
mm/s	millimeter per second
MMS	Marquette Medical Systems
Modem	modulator/demodulator
MOS	metal oxide semiconductor
MPE	metallized polycarbonate expitaxial
ms	milliseconds
MS-DOS	Microsoft Disk Operating System
MTBF	mean time between failures
mtg	mounting
MTR	MOTOR
MUSE	Marquette Universal System for Electrocardiography
mux	multiplexer
mV	millivolt
mVR	minus (inverted) aVR

N

N	neutral
n/a	not available
NA	not applicable
NC	no connection
Nitrate	nitrates
NLQ	near letter quality
NMI	non-maskable interrupt
NMOS	N-channel metal-oxide semiconductor
No	number
NO	normally open
norm	normal
nS	nanoseconds
NSR	Normal Sinus Rhythm

O

O	off, original
OE	other errors
OEM	original equipment manufacturer
OH	off-hook relay
OneSec	one sector
ORG	orange
Orig	original
OUT	output
oz	ounce

P

P	P wave (section of the ECG waveform)
p-p	peak-to-peak
PA	P wave amplitude
Params	parameters

Passwds	passwords
PatData	patient data
PatInfo	patient information
PATN	patient
PC	printed circuit, personal computer
PCB	printed circuit board
pF	picofarad
Pgm	program
PgmId	program identification
Phenoth	Phenothiazide
Phenytn	Phenytoin
PID	patient identification digit
PLCC	plastic leadless chip carrier
PM	power module
pm, PM	post meridiem, preventive maintenance
PM-2	Power Module-2
PM-3	Power Module-3
pn, PN	part number
PNH	pan head
PPA	P wave amplitude
PR	ECG signal interval
Pro-Off	progressive offset
Procain	Procainamide
PROM	programmable read-only memory
Propran	Propranolol
PSK	phase shift keying
PSU	power supply unit
Psych	psychotropic
PUP	pull-up signal
PVC	polyvinyl chloride
PWM	pulse-width modulation
PWR	power
PWR CRD	power cord

Q

Q	transistor
QA	quality assurance, Q wave amplitude
QAD	Quality Assurance Deviation
QAM	quadrature amplitude modulation (phase and amplitude modulation)
QC	quality control
QD	Q wave duration
QRS	QRS complex (portion of ECG waveform), interval of ventricular depolarization
QT	QRS interval
QTC	QRS interval
QTY	quantity
Quinid	Quinidine

R

R	resistor, red, reset
RA	right angle, right arm or R wave amplitude
RAM	random access memory
RC	resistor capacitor
RD	R wave duration
Ref	reference, refresh
REN	Ringer Equivalence Number
Reserp	Reserpine
REV	revision
RevdBy	reviewed by
RevXmit	reverse transmission
rf	radio frequency
RFI	radio frequency interference
RGB	red, green, blue
RI	ring indicate
RL	right leg
RMR	Rhythm and Morphology Report
ROM	read only memory
RPA	R wave amplitude
RPD	R wave duration
rpt, Rpt	report
RTC	real time clock
RTI	relative to patient input
RTN	return
RVS	reverse
R/W	read/write

S

12SL	12 simultaneous leads
s, S	second, select, switch
SA	s wave amplitude
SB	slow-blow
SCL	safe current limits
SD	schematic diagram, S wave duration
SE	serial input/output errors
sec	second
sec.s	seconds
SEER	Solid-state Electronic ECG Recorder
SING	Singapore
SP	Spanish
SPA	S wave amplitude
SPDT	single-pole, double-throw
SRAM	static RAM
ST-T	ST-T wave (section of the ECG waveform)
standrd, Standrd	standard
STD	standard
STE	ST segment displacement at the end
STJ	ST segment displacement at the J point
STM	ST segment displacement at the mid-point between STJ and STE
stmts, Stmts	statements
SumRam	some RAM
supply mains	permanently installed power source
SVT	power cord type; 300 V
sw, SW	switch, software
SW	Swedish, Sweden

T

T Tone	touch tone
TA	T wave amplitude
Tant	tantalum
TDML	treadmill
TE	timeout errors
Tech	technical
Thiazid	Thiazide
TM	trademark
Tot	total number or errors
TP	test point
TPA	T' wave amplitude
TRAM	Transport Remote Acquisition Monitor
Tricyli	Tricylic antidepressant
TTL	transistor-transistor logic, TTL levels
TVS	transient voltage suppressor

U

UE	undefined errors
uF	microfarad
UL	Underwriters' Laboratory, Inc
Unconf	unconfirmed
UUT	unit-under-test

V

v, V	volt, volts
V1-V6	precordial leads
V123	V1, V2, V3
V3R	precordial lead
V456	V4, V5, V6
V4R	precordial lead
V ac	volts, alternating current
V dc	voltage, direct current
VA	volt-amperes
Var	variable
VDE	Verband Deutscher Elektrotechniker (German regulatory agency)
Vent.	ventricular
VF	ventricular fibrillation
VGA	video graphics array
VIA	versatile interface adapter
VIO	violet
Volt	voltage
VRAM	video RAM
vs	versus

W

w/	with
W	watt
Warfar	Warfarin
WHT	white
WI	Wisconsin

X

x	by (as in "8-1/2 x 11")
XCV	transceiver
XYZ	orthogonal leads

Y

Y	year, yellow
yr	year
yrs	years
YY	year

Symbols

↑	SHIFTed or alternate function
µ	micro
µF	microfarad
µs, µsec	microsecond
68K	68000
&	and
#	number
°C	degrees Celsius
°F	degrees Fahrenheit
Ω	Ohm, ohm
%	percent
®	registered
>	greater than
<	less than
±	plus or minus
*	An asterisk after a signal name indicates the signal is active at its relatively lower potential, or "active-low." Signals without the asterisk suffix are active at their relatively higher potential, or "active-high."
12SL	12 simultaneous leads